COPY 2

TDEM SURVEY
WESTERN PORTION OF THE
ISLAND OF MOLOKAI
STATE OF HAWAII

TIME DOMAIN ELECTROMAGNETIC SURVEY
WESTERN PORTION OF THE ISLAND OF MOLOKAI
STATE OF HAWAII

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(Our Project #89033)

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1.0 INTRODUCTION

This report covers the results of the time domain electromagnetic (TDEM) survey performed by Blackhawk Geosciences, Inc. (BGI) for Alpha U.S.A. Inc., (Alpha) on the Island of Molokai, Hawaii. The field work was done between November 29, 1989 and December 13, 1989. The objectives of the survey were to:

1. Map the thickness of the brackish water basal lens underlying the western portion of the island.

2. Identify areas of potential high level dike impounded ground water.

To accomplish these objectives a total of 42 TDEM soundings were performed. These soundings were located on Alpha's property on Molokai and on Molokai Ranch property in areas that are of interest to Alpha.

2.0 SURVEY DESIGN AND DATA ACQUISITION

2.1 GENERAL

The survey was designed to evaluate the ground water resources underlying Alpha's property along with selected areas of the Molokai Ranch. The original scope of the survey was to evaluate only Alpha's property utilizing a scattered placement of TDEM soundings. This would allow a contour map of the depth to saline water to be generated. The objectives of the survey were changed upon arrival in Hawaii to cover a much larger area in approximately the same amount of time. To accomplish this, data acquisition was concentrated in areas with the highest potential for ground water resources. These areas consisted of:

1. The northwest and southwest rift zones of West Molokai along with their intersection at Puu Nana.

2. An area along a proposed brackish water pipeline in Kakaaukuu Gulch.

3. An area of proposed brackish water development southeast of the airport.

For optimum coverage within the available field time constraints, soundings were generally spread three to four thousand feet apart, along lines through the area of interest. Two cross-lines of soundings were made along the southwest rift zone to further evaluate these areas. In the area southeast of the Molokai airport a scattered pattern of soundings was used.

2.2 LOGISTICS

The geophysical survey was conducted by a two man crew from BGI. Two local hires were used to assist in the field work. The equipment was transported in the field utilizing a half-ton four-wheel drive pickup and a Jeep Wrangler. The general areas in which soundings were to be made was determined through discussions between BGI, Alpha, and Alpha's consulting hydrologist, Tom Nance. Specific sounding locations were decided in the field based primarily on access and the results of previous soundings.

The soundings were plotted on a U.S.G.S. 1:25,000 scale map and are shown on Figure 2-1. These locations were surveyed with compass and hip-chain from known locations such as road intersections.

A daily log of field activities is given in Table 2-1. A total of 13.5 days were spent acquiring data. Field work could not be done on December 9 due to heavy rains which made the dirt roads impassable. A total of 42 soundings were made during the

field work. Ten of these soundings were on Alpha's property. The remaining 32 soundings were made on Molokai Ranch property in areas of interest to Alpha.

2.3 DATA ACQUISITION

All soundings were made utilizing the Geonics EM-37 TDEM system with a DAS-54 data logger. Equipment specifications are given in Appendix A. Transmitter loop sizes utilized were 1,000 ft by 1,000 ft for 39 of the soundings; 150 ft by 150 ft for one sounding; and 400 ft by 400 ft for the remaining soundings. The transmitter loop size was determined by (i) available space for laying out the loops, and (ii) required depth of exploration. The current in the loops was 19 amps. The transmitter-receiver array used consisted of center-loop soundings.

At the center of each transmitter loop the time derivative of the vertical magnetic field is measured at several different amplifier gains and opposite receiver polarities. Two different receiver coils with effective areas of 100 m^2 and 1000 m^2 were used. The base frequencies used were 3 Hz and 30 Hz. All data from the soundings were recorded on the DAS-54 data logger for later processing on a portable computer.

Table 2-1. Summary of daily field activities

Date (1989)	Activity
November 28	Mobilize from Denver, CO to Honolulu, HI
November 29	Mobilize from Honolulu to Molokai. Read loop 00. One-half day of field work.
November 30	Read loops 1 and 2
December 1	Read loops 3, 4 and 5
December 2	Read loops 6, 7 and 8
December 3	Read loops 9, 10 and 11
December 4	Read loops 12, 13, 14 and 15
December 5	Read loops 16, 17 and 18
December 6	Read loops 19, 20 and 21
December 7	Read loops 22, 23 and 24
December 8	Read loops 25, 26 and 27.
December 9	Heavy rains would not allow off-road field work.
December 10	Read loops 28, 29, 30 and 31
December 11	Read loops 32, 33, 34 and 35
December 12	Read loops 36, 37 and 38
December 13	Read loops 39, 40 and 41
December 14	Pack and ship equipment to Kona, HI.

MAP GOES HERE

3.0 DATA PROCESSING

The processing of the TDEM data consists of the following steps:

1. The raw data at each station were edited and averaged together in pairs.

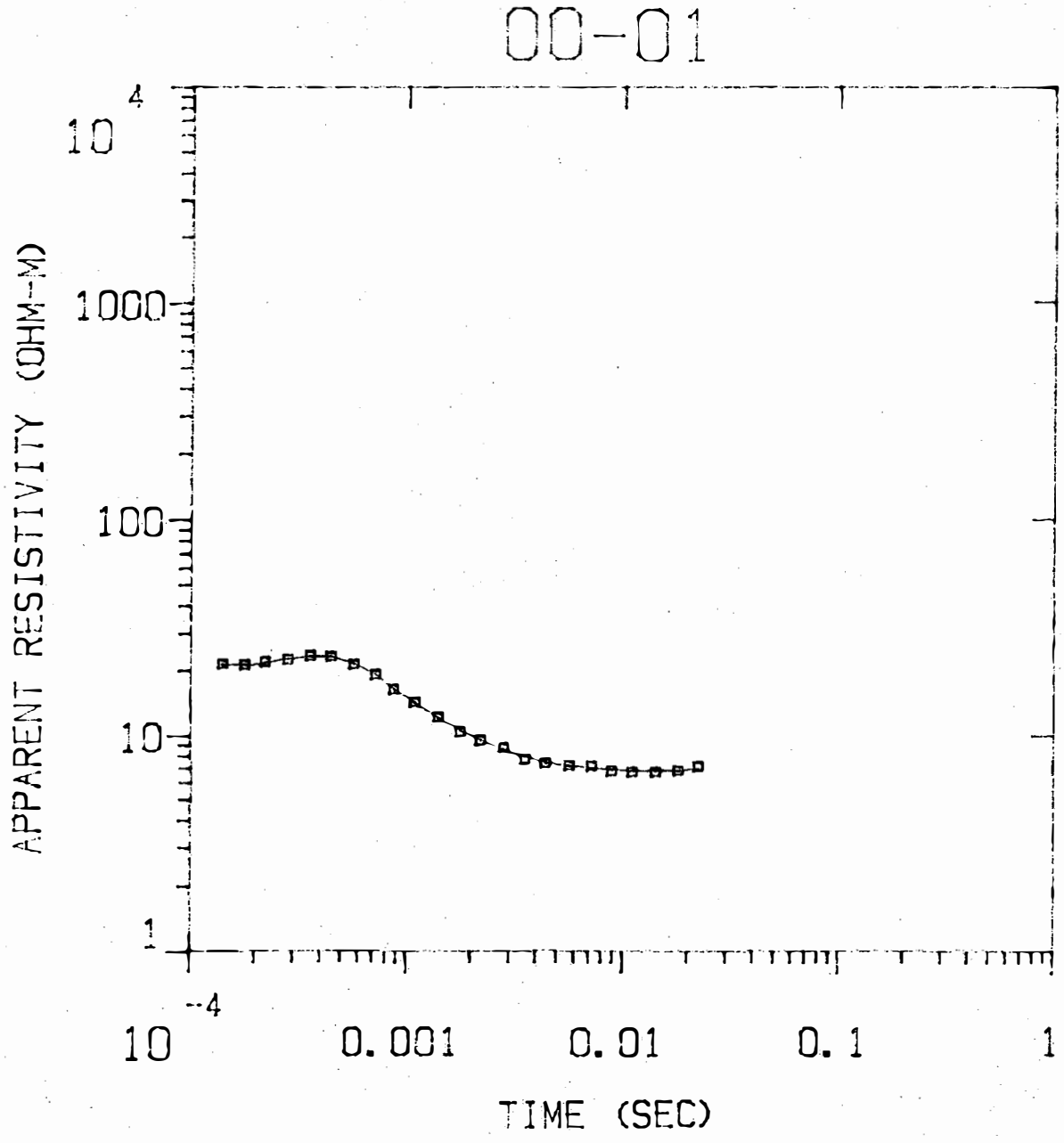
2. Data pairs were edited for each base frequency and terminated at the point where excessive noise or minimum signal occurs.

3. Data pairs and base frequencies are averaged together to form one data set over the largest time range possible.

4. The data set produced in Step 3 is entered into an Automatic Ridge Regression Transient Inversion program.

The inversion program transfers the data into apparent resistivity values versus time. A starting geoelectric model (consisting of the number of layers, resistivities and thicknesses for each layer) is entered into the program. The inversion program then automatically adjusts the model parameters to obtain the best fit between the model and the field data. For all calculations a one-dimensional (horizontally layered) model is assumed.

The results of the transient inversion program from a typical sounding (sounding 1) are shown in Figures 3-1 and 3-2. Figure 3-1 shows the experimentally measured apparent resistivity data superimposed on the computed behavior (solid line) of subsurface resistivity layering that best matches the observed data. The resistivity layering of the best match is shown on the right. Figure 3-2 lists gate number, time, measured data, computed values, and errors for each time gate, as well as overall RMS error. The results of the 42 soundings are contained in Appendix B.



MODEL:

7.83 OHM-M	18.5 M
201. OHM-M	63.7 M
2.12 OHM-M	35.4 M
7.27 OHM-M	199. M
14.1 OHM-M	

EXAMPLE OF INVERSION RESULTS

% ERROR: 1.78
CALIBRATION: 1
OFFSET: 61.0 M
RAMP: 50.0
Blackhawk Geosciences

FIGURE 3-1

EXAMPLE OF INVERSION DATA SHEET

FIGURE 3-2

00-01

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		67.1	220.0		
7.83	18.5	48.6	159.4	2.4	2.4
200.64	63.7	-15.1	-49.5	0.3	2.7
2.12	35.4	-50.5	-165.7	16.7	19.4
7.27	198.8	-249.3	-817.9	27.3	46.7
14.08					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	1.40E-04	2.13E+01	2.13E+01	-0.076	
2	1.77E-04	2.12E+01	2.12E+01	-0.131	
3	2.20E-04	2.19E+01	2.17E+01	0.708	
4	2.80E-04	2.25E+01	2.27E+01	-0.836	
5	3.55E-04	2.35E+01	2.34E+01	0.433	
6	4.43E-04	2.32E+01	2.31E+01	0.235	
7	5.64E-04	2.14E+01	2.15E+01	-0.730	
8	7.13E-04	1.91E+01	1.90E+01	0.602	
9	8.81E-04	1.64E+01	1.65E+01	-0.537	
10	1.10E-03	1.43E+01	1.42E+01	0.598	
11	1.41E-03	1.21E+01	1.20E+01	0.800	
12	1.78E-03	1.04E+01	1.05E+01	-1.328	
13	2.21E-03	9.45E+00	9.47E+00	-0.207	
14	2.83E-03	8.79E+00	8.58E+00	2.527	
15	3.55E-03	7.78E+00	7.96E+00	-2.260	
16	4.43E-03	7.45E+00	7.52E+00	-0.950	
17	5.64E-03	7.18E+00	7.17E+00	0.017	
18	7.13E-03	7.12E+00	6.94E+00	2.593	
19	8.81E-03	6.75E+00	6.80E+00	-0.754	
20	1.10E-02	6.68E+00	6.73E+00	-0.795	
21	1.41E-02	6.67E+00	6.72E+00	-0.696	
22	1.80E-02	6.78E+00	6.79E+00	-0.124	
23	2.22E-02	7.08E+00	6.92E+00	2.427	

R: 61. X: 0. Y: 61. DL: 122. REQ: 68. CF: 1.0000
CLHZ ARRAY, 23 DATA POINTS, RAMP: 50.0 MICROSEC, DATA: 00-01

RMS LOG ERROR: 7.67E-03, ANTILOG YIELDS 1.7810 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.99							
P 2	-0.02	0.01						
P 3	0.03	0.00	0.88					
P 4	0.02	0.00	-0.07	0.93				
P 5	0.00	-0.01	-0.01	-0.04	0.86			
T 1	-0.02	-0.06	0.05	0.02	0.00	0.97		
T 2	0.00	0.02	0.02	0.01	0.00	-0.01	1.00	
T 3	0.05	0.00	-0.19	-0.12	-0.03	0.08	0.03	0.68

4.0 INTERPRETATION

4.1 GENERAL

The results of the TDEM soundings is a geoelectric section consisting of various layers with certain resistivities and thicknesses. In order to meaningfully interpret the soundings the geoelectric section needs to be converted into a geohydrologic section. This is normally done by assigning rock types and/or pore water salinities to various ranges of resistivities. The optimum method of determining characteristic ranges of resistivity is to obtain high quality electric logs from wells that penetrate different rock types and ground water salinities. For the Island of Molokai these types of logs were not available. In this case the correlation between resistivities and the geohydrologic section were made by several means. These include

- test soundings
- integration of known geology and sounding results
- comparison with similar geohydrologic environments (primarily the Island of Hawaii).

The geology of Molokai is described in BGI's report on the Resource Evaluation of the Island of Molokai, Hawaii. There are three main rock types on West Molokai. These are

- lateritic soil
- permeable pahoehoe and aa lava flows
- relatively massive igneous intrusives.

The lateritic soil is developed through intense weathering of the lava flows. This weathering profile probably extends into rocks beneath the soil zone. Because of this, the laterite zone as determined by electrical methods likely extends deeper than what would normally be considered strictly soil.

The lava flows effect bulk resistivity primarily through variations in porosity which can range from 10% to 50%. This is probably the cause of an increase in resistivity seen at depth in many of the soundings. In sea water saturated rocks, it is common to observe a resistivity increase with depth which is from less than 10 ohm-m up to 20 to 30 ohm-m. This is most likely due to a porosity decrease in the rocks due to either (i) change to a denser lava flow, or (ii) greater compaction of the lavas due to increased depth of burial.

The TDEM survey did not identify massive igneous intrusives, although numerous dikes too small to be detected are present in the region. These larger intrusives would be expected to have

resistivities of greater than several hundred ohm-m and would be located at depth in the geohydrologic section.

The second major factor affecting resistivity is the salinity of the contained ground water. The bulk resistivity of an unaltered or moderately altered rock unit is lowered significantly when it is saturated with saline water. This contrast in resistivity is readily detectable using electrical geophysical methods. From the present work on Molokai it does not appear possible to distinguish whether a rock is unsaturated, saturated with fresh water, or saturated with brackish water (up to 2,000 ppm Cl). The literature states that the basal ground water lens is brackish in this portion of the island. In this report the basal lens will be referred to as brackish, although its salinity, which should be less than 2,000 ppm Cl, cannot be directly determined.

The third factor affecting the resistivity of the geohydrologic section is the amount of clay contained within the unit. Increasing the amount of clay within a rock will generally decrease its bulk resistivity. Since clay is usually not a major primary component of volcanics the amount contained in a unit is a function of post-depositional alteration of the volcanics. This alteration may be due to hydrothermal systems or weathering.

The assigned characteristic resistivity ranges are shown in Figure 4-1. The most extensive overlap of the ranges is between lateritic soil and fresh water saturated volcanic flows. Since significant thicknesses of lateritic soil occur only at the surface, these two units can be separated by position in the section. A distinction between intrusives and the resistive volcanic flows can also be made by their relative position in the geoelectric section. Intrusives of sufficient size to be detected are expected to occur at depth. Sea water saturated volcanics are not thought to occur beneath the intrusives. In the present survey no large intrusive bodies were directly identified.

An important relationship used in the interpretation of the TDEM survey is the Ghyben-Herzberg principle. This principle states that for every foot the fresh water table stands above sea level, the base of the fresh water will be approximately 40 ft below sea level (Fig. 4-2). Utilizing this principle it is assumed that fresh or brackish water is present at a sounding location from approximately sea level down to the top of the saline water saturated rocks.

4.2 RESULTS

The results of the survey are discussed in terms of five separate areas

- Southwest Rift
- Northwest Rift
- Puu Nana Area
- Proposed brackish water line (Kakaaukuu Gulch)
- Proposed brackish water development (SE of Molokai airport).

The two rifts merge in the area of Puu Nana. There is however a significant difference in the geohydrologic sections of the rifts in the area of Puu Nana.

4.2.1 Southwest Rift

Alpha Property

The results of the soundings over the Alpha Ranch property are shown in Figures 4-3 and 4-4. From the data, brackish ground water appears to be contained in a basal lens situation. The depression of the saline water interface below sea level is not large in this area. Sounding 3 shows the thickest brackish water lens in this area which is approximately 120 ft. This lens, however, thins rapidly to only a few tens of feet in adjacent soundings. Based on the results of the soundings and the low recharge in the area of Alpha's property it is unlikely that a significant sustainable supply of fresh and/or brackish water is present.

Molokai Ranch Property

The Molokai Ranch property along the Southwest Rift is shown on Figures 4-3 and 4-5. The section shown on Figure 4-5 is consistent from soundings 10 through 17. The top of the saline water in these soundings is close to sea level, except for sounding 12 which shows it to be at approximately 300 ft below sea level. The basal lens detected in sounding 12 thins to less than 100 ft in the adjacent soundings and appears to be isolated possibly due to dike impoundment.

Sounding 16 shows the lower conductive zone extending to 230 ft above sea level. In the other soundings in the area, this lower zone is the result of saline water saturating the rocks. This is not likely the case for the portion of the zone above sea level. Most likely this anomalous conductive zone is caused by alteration of the rocks with the development of clays.

4.2.2 Northwest Rift

The soundings along the Northwest Rift are shown in Figure 4-6. Soundings 23 and 24 show a consistent geohydrologic section. The elevation of the top of the saline water ranges from 120 to 250 ft below sea level. Well #1, which is located adjacent to sounding 22, reports the brackish water table to be at an elevation of 5.6 ft above sea level. Using the Ghyben-Herzberg principal the brackish-saline water interface should be approximately at 224 ft below sea level. This differs from sounding 22 which shows the saline interface to be at 115 ft. This difference may be due to several factors such as surveying errors in drill hole location, or a change in the brackish water lens over the years since the hole was drilled. The soundings adjacent to sounding 22 show the saline layer to be at depths consistent with the drill hole.

Sounding 29 within the rift shows depth to the saline water to be 584 ft below sea level. This is over twice as far below sea level as adjacent sounding 24. This rapid thickening of the basal lens is likely caused by vertical dikes which influence the ground water flow.

4.2.3 Puu Nana

The area of Puu Nana was the main vent area for the West Molokai volcanics. The geohydrologic section as interpreted from the TDEM soundings is significantly different from those seen elsewhere on the island. The Puu Nana area is shown in soundings 30 through 21 on Figure 4-3 and soundings 18 through 21 on Figure 4-6. The main feature in this area is the probable development of hydrothermal alteration, which is most likely associated with the vent. This alteration lowers the resistivity of the dry or brackish water saturated volcanic flows by increasing clay content and increases the resistivity of saline water saturated flows through a decrease in porosity. This causes an overlap in the characteristic ranges of resistivities between saline water saturated lenses and dry or brackish water saturated lenses, and prevents distinguishing between the two in the soundings.

As can be seen from the cross sections, low resistivity material extends from well below sea level to several hundred feet above sea level in five of the six soundings in the Puu Nana region. Sounding 20 is significantly different from the other soundings in the area. It shows resistive material (150 ohm-m) extending to a depth of approximately 1,100 ft below sea level. The relatively high resistivity of this zone indicates that sea water has not infiltrated into it. The isolation of the region is probably due to high angle dikes which prevents the influx of sea water. From the sounding, the exact salinity of any

contained ground water in this resistive zone cannot be determined. The rocks should, however, vary from being dry in the upper portion of the zone to being saturated with fresh to slightly brackish ground water in the lower portions.

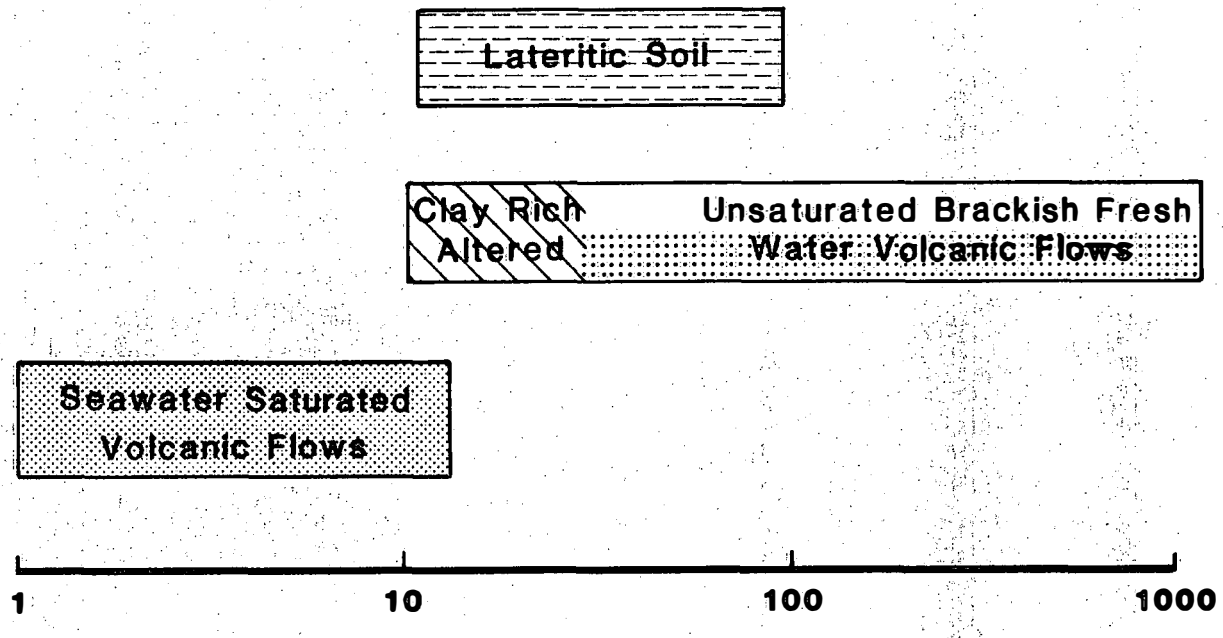
4.2.4 Proposed Brackish Water Line (Kakaaukuu Gulch)

The results of the five soundings from this area are shown in Figure 4-7. Soundings 32 through 34 show a relatively thin (< 100 ft thick) brackish water lens. In soundings 31 and 35 the lens thickens to over 300 ft. To explain the abrupt change in the thickness of the basal brackish water lens, a near-vertical damming structure such as a dike must exist between soundings 31 and 32. It is likely that dikes occur in this area due to its proximity to the main volcanic vent at Puu Nana.

4.2.5 Proposed Brackish Water Development (SE of Airport)

Six soundings were made in this area to map the basal ground water lens. The results of these soundings are shown in Figures 4-8 through 4-10. Figure 4-10 shows the thickness of the brackish water lens increasing from south to north.

Five of the six soundings show a consistent geohydrologic section. Sounding 39, however, does not show a well-defined saline water interface below sea level. This sounding is similar to soundings in the area of Puu Nana which show conductive material extending above sea level. This is probably caused by hydrothermal fluids altering the rock and obscuring the difference in resistivities between saline water saturated rocks and dry to brackish water saturated rocks. The source of this system may be the vent or intrusive present at Kualapuu which is within 3,500 ft of the sounding.

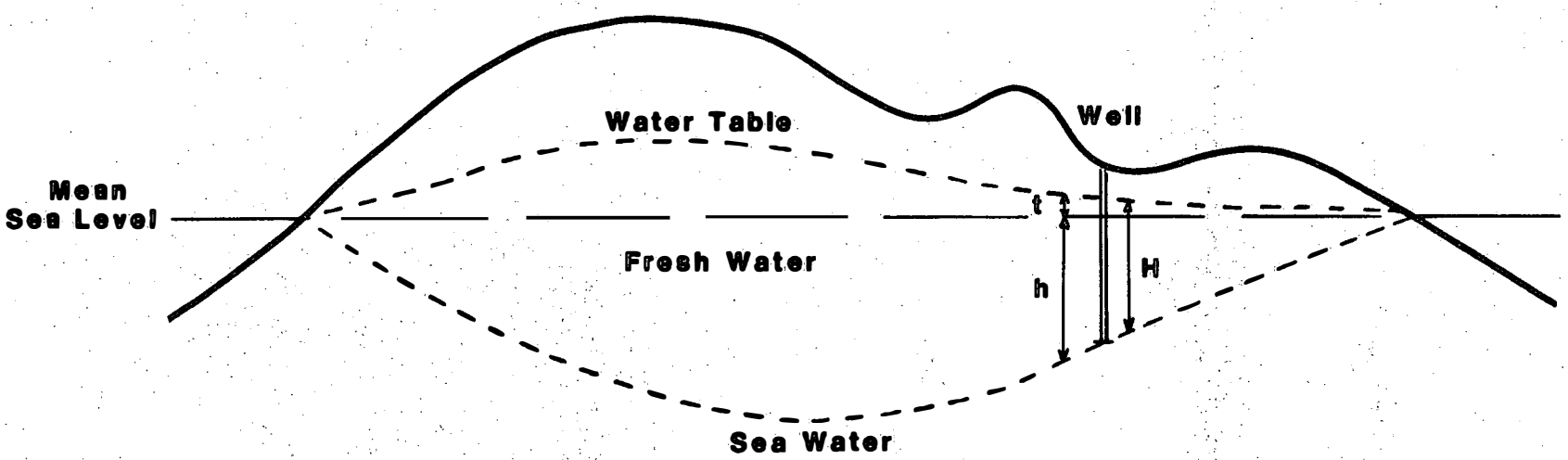


BLACKHAWK GEOSCIENCES, INC.

CHARACTERISTIC RESISTIVITY RANGES

Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-1



$t = 1/40\ (h)$

FROM: HERZBERG

BLACKHAWK GEOSCIENCES, INC.

Illustration of the
Ghyben-Herzberg Principle

PROJECT NO.: 89033 FIGURE 4-2

A
SOUTHWEST

ALPHA

MOLOKAI RANCH

A′
NORTHEAST

SOUNDING LOCATIONS

0 1 2 3 4 5 10 11 12 13 14 15 16 17 18 19 20 21

ELEVATION (feet)

1500
1000
500
SEA LEVEL
-500
-1000
-1500

All Values in Ohm-m

LEGEND

- Lateritic Soil
- Clay Rich Altered Volcanics
- Seawater Saturated
- Brackish Fresh Water Lens

5000 0 5000

SCALE - FEET

VERTICAL EXAGERATION 10 TO 1

BLACKHAWK GEOSCIENCES, INC.

GEOELECTRIC CROSS SECTION
TDEM SURVEY, LINE A – A′
Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-3

B

SOUTH

APPROXIMATE RIFT BOUNDARY

B′

NORTH

SOUNDING LOCATIONS

9 5 8 6 7

600
400
200
SEA LEVEL
-200
-400
-600

ELEVATION (feet)

449
30
3.2
43
9.3
120
25
50
3.0
2.5
3.5
2.4
3.1
25
7.0
15.2
13.9
8.9

All Values in Ohm-m

LEGEND

- Lateritic Soil
- Clay Rich Altered Volcanics
- Seawater Saturated
- Brackish Water Lens

1000 0 1000

SCALE - FEET

VERTICAL EXAGERATION 5 TO 1

BLACKHAWK GEOSCIENCES, INC.

GEOELECTRIC CROSS SECTION
TDEM SURVEY, LINE B – B′
Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-4

C

SOUTH

C′

NORTH

SOUNDING LOCATIONS

APPROXIMATE RIFT BOUNDARY

APPROXIMATE RIFT BOUNDARY

36 12 37 38

ELEVATION (feet)

800
600
400
200
SEA LEVEL
-200
-400
-600

30
6.3
26
15
15.5
10
49
16
921
28
1164
962
9.3
4.3
2.7
5.6
6.0

All Values in Ohm-m

LEGEND

- Lateritic Soil
- Clay Rich Altered Volcanics
- Seawater Saturated
- Brackish Water Lens

1000 0 1000

SCALE - FEET

VERTICAL EXAGERATION 5 TO 1

BLACKHAWK GEOSCIENCES, INC.

GEOELECTRIC CROSS SECTION
TDEM SURVEY, LINE C – C′
Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-5

D

NORTHWEST

D'

SOUTHEAST

SOUNDING LOCATIONS

ELEVATION (feet)

1500
1000
500
SEA LEVEL
-500
-1000
-1500

23 22 24 29 30 28 Puu Nana 20 21

Approximate Location Well #1

47 2 38 7.4 43 6.2 25 63 61 16 49 9.7 27 46 15

140 63 280 21 1100 400 150 250

1.9 6.1 5.4 43 23 3.3 ? 15 ? 12 ? 6.9 9.3 19

All Values in Ohm-m

LEGEND

- Lateritic Soil
- Clay Rich Altered Volcanics
- Seawater Saturated
- Brackish Water Lens

2000 0 2000

SCALE - FEET

VERTICAL EXAGERATION 5 TO 1

BLACKHAWK GEOSCIENCES, INC.

GEOELECTRIC CROSS SECTION

TDEM SURVEY, LINE D – D'

Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-6

E

SOUTH

E′

NORTH

SOUNDING LOCATIONS

31 35 32 33 34

ELEVATION (feet)

800 600 400 200 SEA LEVEL -200 -400 -600 -800

124 1.7 ? ? ? ? 30 6.6 15 119 2.1 19 158 57 127 84 2.6 63 87 3.7 3.6 4.5 2.4 4.2 10 22 10 29

All Values in Ohm-m

LEGEND

- Lateritic Soil
- Clay Rich Altered Volcanics
- Seawater Saturated
- Brackish Water Lens

1000 0 1000

SCALE - FEET

VERTICAL EXAGERATION 5 TO 1

BLACKHAWK GEOSCIENCES, INC.

GEOELECTRIC CROSS SECTION
TDEM SURVEY, LINE E – E′
Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-7

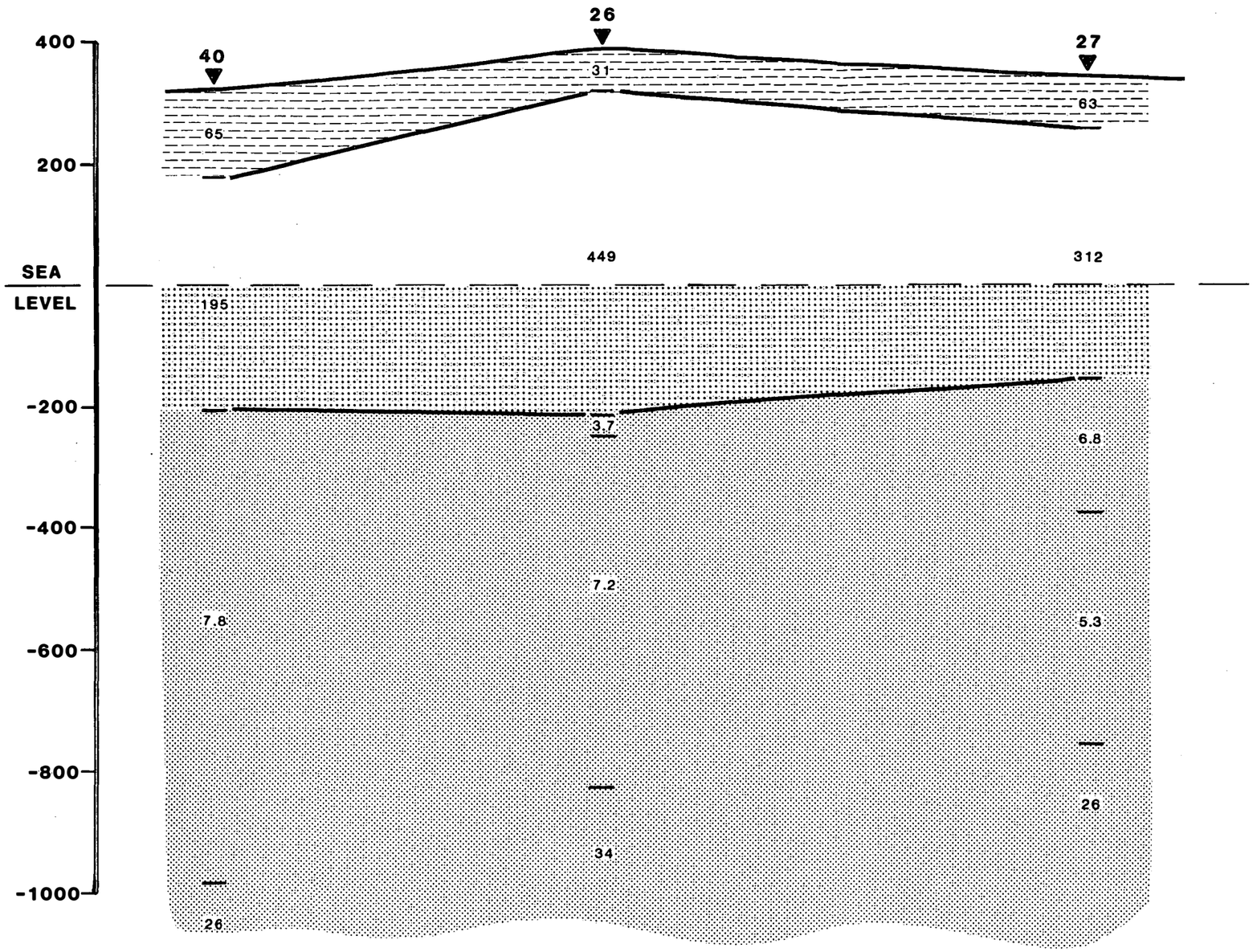
F

WEST

SOUNDING LOCATIONS

F′

EAST



All Values in Ohm-m

LEGEND

- Lateritic Soil
- Clay Rich Altered Volcanics
- Seawater Saturated
- Brackish Water Lens

1000 0 1000

SCALE - FEET

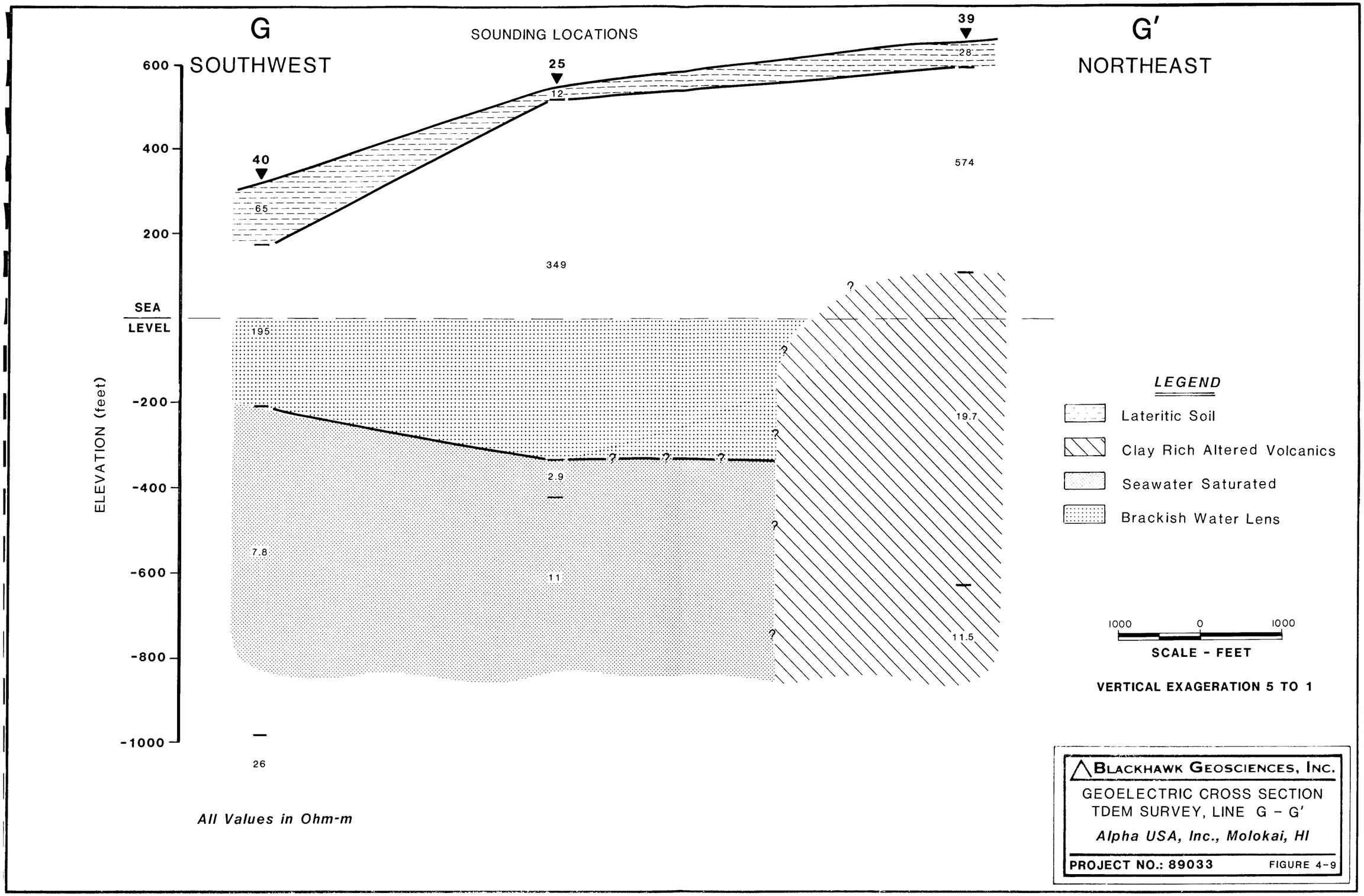
VERTICAL EXAGERATION 5 TO 1

BLACKHAWK GEOSCIENCES, INC.

GEOELECTRIC CROSS SECTION
TDEM SURVEY, LINE F – F′

Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-8

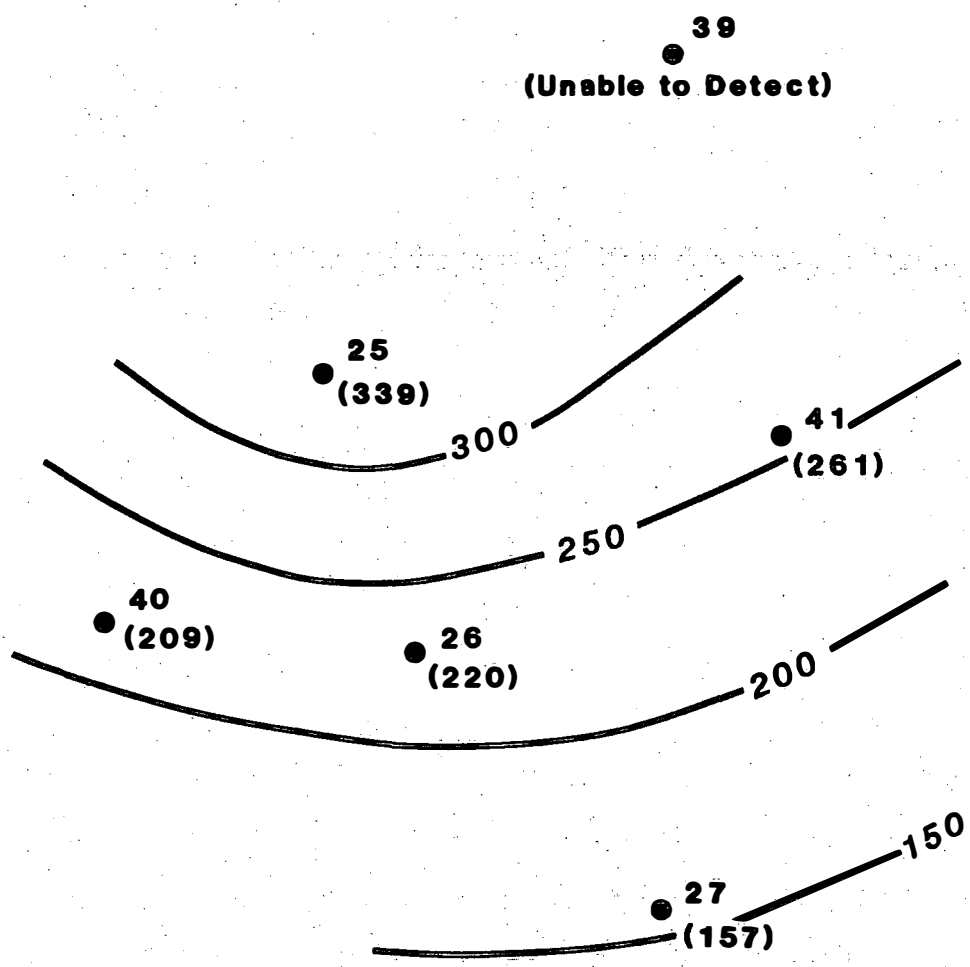


BLACKHAWK GEOSCIENCES, INC.

GEOELECTRIC CROSS SECTION
TDEM SURVEY, LINE G – G′

Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-9



LEGEND

Well #

22
(234)

Thickness of Brackish Water Lens (feet)

BLACKHAWK GEOSCIENCES, INC.

THICKNESS OF
BRACKISH WATER LENS
Proposed Brackish Water
Development Area
Alpha USA, Inc., Molokai, HI

PROJECT NO.: 89033 FIGURE 4-10

5.0 CONCLUSIONS AND RECOMMENDATIONS

The TDEM soundings were effective in outlining the geohydrologic system on the Island of Molokai. The interface between saline ground water and the overlying brackish basal lens was clearly mapped in most of the soundings. The soundings in which the interface was not detected are primarily in the area of the main West Molokai volcanic vent around Puu Nana. The interface is obscured in these soundings most likely by alteration of the volcanics due to large hydrothermal cells developed around the time of the eruptions.

The results of the survey are summarized as follows:

1. The brackish ground water basal lens detected on Alpha's property is relatively thin (< 120 ft).

2. Along the Southwest Rift, Sounding 12 shows a basal lens approximately 350 ft thick. The lens thins rapidly in adjacent soundings and appears to be isolated.

3. Three of the soundings along the Northwest Rift show a basal ground water lens 100 to 250 ft thick. Sounding 29 shows the lens thickening to around 600 ft.

4. Sounding 20 in the area of Puu Nana shows a zone extending to 1,100 ft below sea level in which no sea water has infiltrated. This is probably the result of dike impoundment. The saline water saturated boundary is obscured in adjacent soundings due to alteration.

5. Soundings in the Kakaaukui Gulch area show an abrupt thickening of the basal ground water lens from less than 100 ft to over 300 ft. This is probably controlled by dike impoundment.

6. The area southeast of the Molokai airport shows a gradual thickening of the basal ground water lens from approximately 160 ft on the south near the quarry along Manawainui Gulch to over 300 ft near Puu Kanaio.

In expanding the survey from its original scope of covering Alpha's property to covering a large portion of Molokai Ranch, the density of soundings was decreased. In areas where a relatively thick basal ground water lens was identified, additional soundings are required to outline the lateral extent of the lens. Additional soundings are recommended in the following areas

- adjacent to sounding 20 near Puu Nana
- perpendicular to the line of soundings in the Northwest Rift at sounding 29
- in the area of Kakaaukui Gulch near soundings 31 and 35
- in the area southwest of the Molokai airport if additional detail is required.

The locations and number of soundings required for each area would be determined based on Alpha's specific objectives for each area.

GEONICS LIMITED

EM37 Ground Transient Electromagnetic System
Technical Specifications

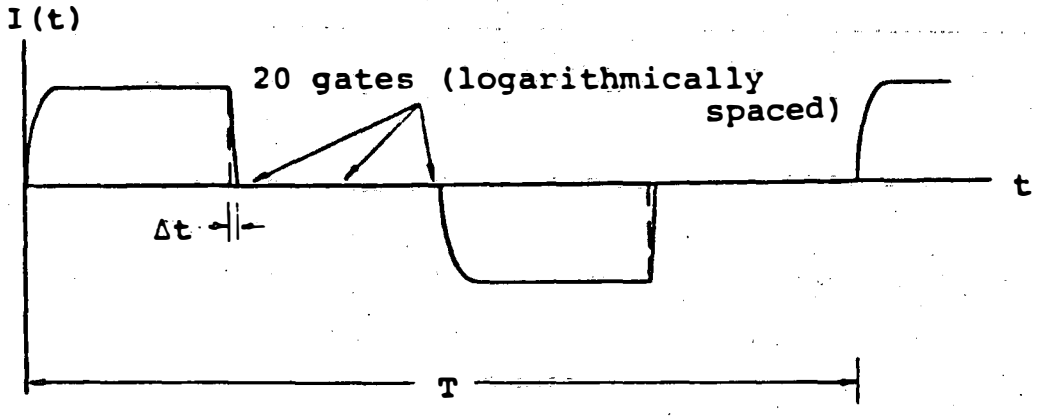
Transmitter

Current Waveform	See Figure 1
Repetition Rate	3Hz or 30Hz in countries using 60 Hz power line frequency; 2.5Hz or 25Hz in countries using 50Hz power line frequency; all four base frequencies are switch selectable.
Turn-off Time (Δt)	fast linear turn-ff of maximum 300 usec. at 20 amps into 300x600m loop. Decreases proportionally with current and loop area$^{\frac{1}{2}}$ to minimum of 20 usec. Actual value of Δt read on front panel meter.
Transmitter Loop	any dimensions from 40mx40m to 300mx600m maximum at 20 amps. Larger dimensions at reduced current. Transmitter output voltage switch adjustabe for smaller loops. Value of loop resistance read from front panel meter; resistance must be greater than 1 ohm on lowest voltage setting to prevent overload.
Transmitter Protection	circuit breaker protection against input over-voltage; instantaneous solid state protection against output short circuit; automatically resets on removal of short circuit. Input voltage, output voltage and current indicated on front panel meter.
Transmitter Output Voltage	160 volts (zero to peak) maximum; 20 volts (zero to peak) minimum
Transmitter Output Power	2.8 kw maximum
Transmitter Wire Supplied	1800m. #10 copper wire PVC insulated with nylon jacket; transmitter wire contained on 6 reels (supplied); 2 reel winders supplied.
Transmitter Motor Generator	5 HP Honda gasoline engine coupled to 120 volt, 3 phase, 400Hz alternator. Approximately 8 hours continuous operation from full (built-in) fuel tank.

GEONICS LIMITED

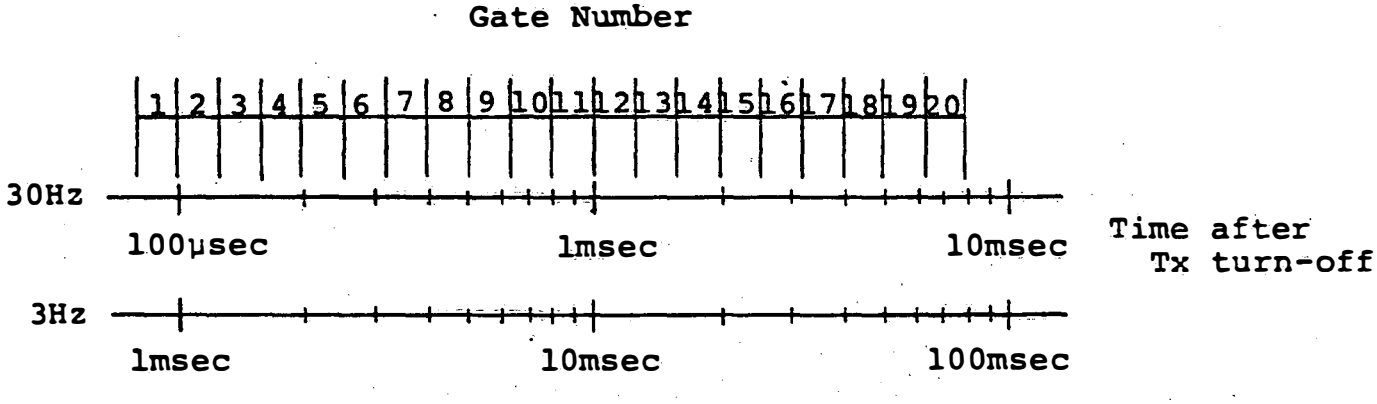
Receiver

Measured Quantity	time rate of decay of magnetic flux along 3 axes.
Sensor	air-cored coil of bandwidth 40 kHz; 1m dia. by 7cmx5cm cross-section. Coil holder supplied to facilitate measurement along 3 axes.
Time Channels	20 time channels with locations and widths as shown in Figure 2. Successive operation at 30Hz, then 3Hz, effectively gives 30 channels covering range from 80 usec. to 80msec.
Output Display	4 digit plus sign LED display; display also shows channel number and gain.
Integration Time	2^n cycles at 30 Hz; n=4,6,8,10,12,14 (switch selectable); similar integration times at other base frequencies.
Receiver Output Noise	typically 1.5×10^{-10} volt/m^2 at last gate at 30 Hz with integration time of 34 seconds. Noise will be higher during intense local spherics activity.
Output Connector	all 20 channels in analog format and house-keeping functions in digital format available from output connector.
Synchronization to TX	any of the following (switch selectable) (1) reference cable (2) primary pulse (3) 27 MHz radio link (40 channels) (4) high stability (oven controlled) quartz crystals.
Noise Rejection Circuitry	Selective clipping of atmospheric noise pluses at all times. Audio output of RX coil (transmitter pulse blanked out) is available on built-in loud speaker for ready indentification of interference.
Receiver Batteries	12 volt rechargeable Gel-cell; 9 hours continuous operating time at 17°C. Two batteries and a battery charger supplied to permit charging of second battery from transmitter motor generator during survey.



Transmitter Current Waveform

FIG. 1



Gate Location and Widths (30 and 3Hz)

FIG. 2

1. PHYSICAL

Dimensions	- 16 X 23 X 21 cm
Weight	- 3.1 kg

2. ENVIRONMENTAL

Operating Temperature	- -30°C to +60°C

3. ELECTRICAL

Power Requirements

Normal Mode	- 500mA at 12 volts = 6.00 watts
Power Save Mode	- 275mA at 12 volts = 3.30 watts
Display Heater	- 600mA at 12 volts = 7.2 watts (Only when it turns on)
Analog Inputs	- ±7 volts maximum - Single ended (Signal Ground is return)
Analog Input Impedance	- Approximately 220KΩ minimum each line
Digital Inputs	- All lines except Integration Time + 12 V = HIGH = Logic 1 0V = LOW = Logic 0 - Integration Time + 8 V = HIGH = Logic 1 0V = LOW = Logic 0 - Single ended (Power Ground is return)
Digital Input Impedance	- All lines except Integration Time Approximately 23KΩ minimum each line - Integration Time Approximately 15KΩ minimum each line
Analog to Digital Converter	- 12 bits plus sign (13 bits) resolution CMOS Dual Slope Integrating type
Signal Resolution	- 7.000 V/4096 = 1.709 mV

4. INPUT AND OUTPUT CONNECTIONS

Input Data Via	- keyboards and 50 pin "D" connector AMP P/N 205869-2

Pin assignments for the connector are as follows:

PIN	DESCRIPTION	PIN	DESCRIPTION
1	Ch 1	5	Ch 5
2	Ch 2	6	Ch 6
3	Ch 3	7	Ch 7
4	Ch 4	8	Ch 8

4. INPUT AND OUTPUT CONNECTIONS (continued)

PIN	DESCRIPTION
9	Ch 9
10	Ch 10
11	Ch 11
12	Ch 12
13	Ch 13
14	Ch 14
15	+12V Power
16	+12V Power
17	NC
18	Ch 18
19	Ch 19
20	Ch 20
21	Ch 0 (Primary Field)
22	T/O Time
23	Freq (MSB)
24	Radio
25	P. Pulse
26	Crystal
27	Ref.
28	Integration Time $\tau 0$ (LSB)
29	Integration Time $\tau 1$

PIN	DESCRIPTION
30	Integration Time $\tau 2$ (MSB)
31	NC
32	+12V Power
33	+12V Power
34	Power Ground
35	Mode ϕ (LSB)
36	Freq (LSB)
37	Mode 1 (MSB)
38	Ch 15
39	Ch 16
40	Ch 17
41	Gain 0 (LSB)
42	Gain 1
43	Gain 2
44	Gain 3 (MSB)
45	Power Ground
46	Signal Ground
47	Signal Ground
48	Power Ground
49	Power Ground
50	Polarity

$\tau 2$	$\tau 1$	$\tau 0$	INT. TIME
0	0	0	4
0	0	1	6
0	1	0	8
0	1	1	10
1	0	0	12
1	0	1	14

MSB	LSB	FREQ.
0	0	LOW
0	1	MED
1	0	HIGH

PIN 50	POLARITY
1	Positive
0	Negative

MODE 1 MSB	MODE ϕ LSB	MODE
0	0	CAL
0	1	NULL
1	0	OPR

4. INPUT AND OUTPUT CONNECTIONS (continued)

PIN				SYNC. MODE
27	26	25	24	
0	0	0	1	Radio
0	0	1	0	P. Pulse
0	1	0	0	Crystal
1	0	0	0	Ref.

GAIN				GAIN
3	2	1	0	
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

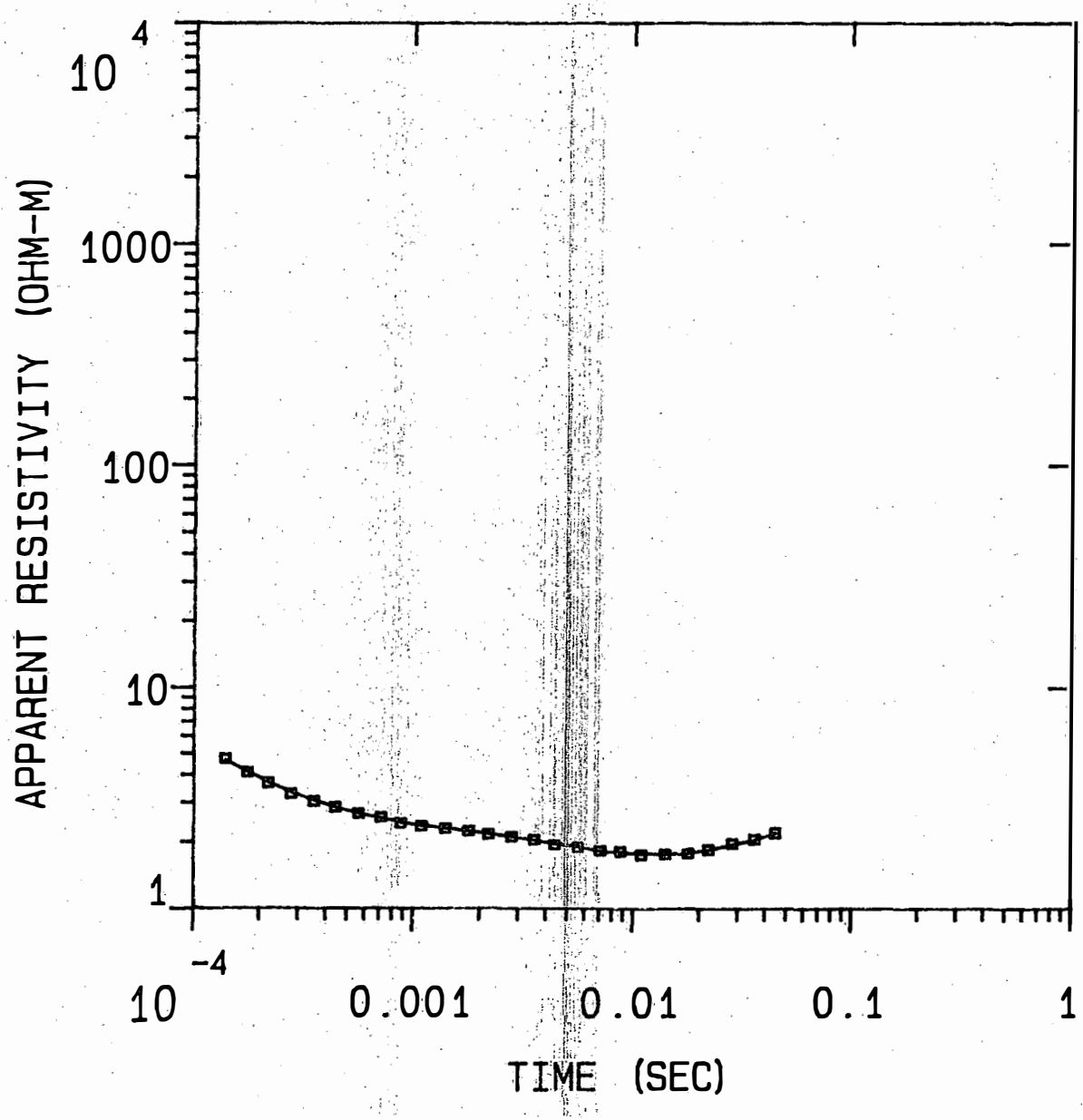
Output Data via - Standard RS-232C port a 25 pin "D" connector

ITT CANNON P/N DB-25S

5. FEATURES:

Storage Medium	- CMOS STATIC RAM with Battery back-up.
Maximum Storage	- with 32K bytes of memory, 511 records; - with 64K bytes of memory, 959 records.
Recording Time	- One record of 22 analog channels, 6 digital channels, and the header, takes about 17 seconds.
Analog Channels	- 22 which consist of: 1 Primary field channel; 1 Turn-off (T/O) channel; 20 Output channels.
Digital Channels	- 6 which consist of the Mode; Sync. Mode; Freq.; Gain; Integration time; and Polarity.
Header	- 5 user inputs which consist of the Day; Month; Line; Station; and Component.
Keyboard	- Two (sealed); one for header information; one for numerals.
Display	- 16 Character alphanumeric LCD with heater for low temperature capability. Heater switches on and off automatically as necessary when the temperature drops to about 3°C.
Data Recall	- Data can easily be recalled to the display.
Power Save	- Allows shutdown of some of the circuitry to save approximately 225mA at 12V = 2.7 watts.

000-000



MODEL:

29.5 OHM-M	4.85 M
1.87 OHM-M	65.1 M
1.42 OHM-M	76.9 M
9.68 OHM-M	

% ERROR: 1.13
CALIBRATION: 1
OFFSET: 22.9 M
RAMP: 55.0

Blackhawk Geosciences

000-000

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		9.1	30.0		
29.48	4.8	4.3	14.1	0.2	0.2
1.67	65.1	-60.8	-199.5	34.3	35.0
1.42	7.9	-67.7	-221.9	5.5	40.5
.68					

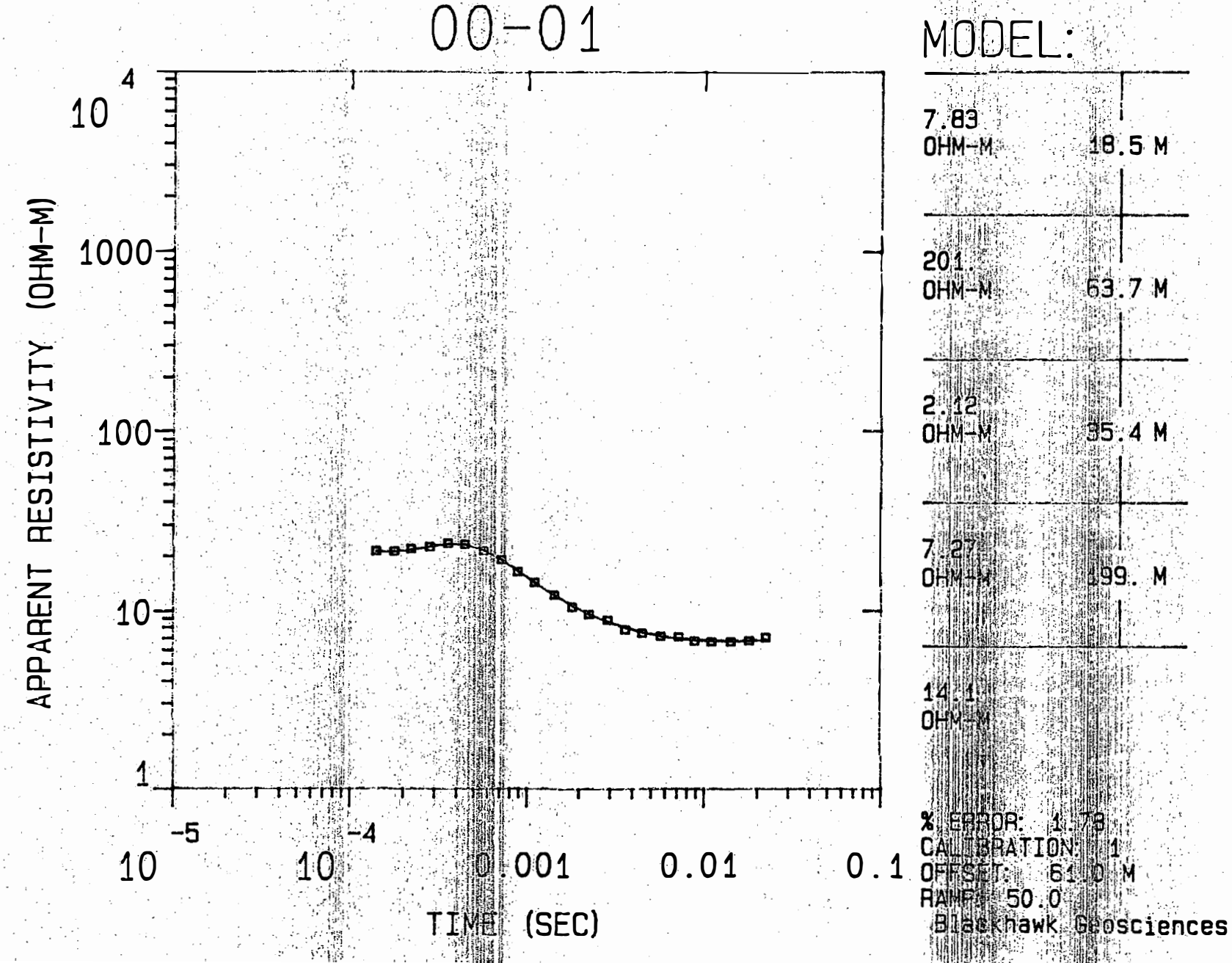
	TIMES	DATA	CALC	% ERROR	STD ERR
1	1.40E-04	4.17E+00	4.19E+00	-0.474	
2	1.77E-04	4.15E+00	4.17E+00	-0.447	
3	2.20E-04	3.67E+00	3.70E+00	-0.869	
4	2.80E-04	3.28E+00	3.32E+00	-1.248	
5	3.55E-04	3.04E+00	3.07E+00	-0.936	
6	4.43E-04	2.85E+00	2.85E+00	0.031	
7	5.64E-04	2.67E+00	2.67E+00	-0.013	
8	7.13E-04	2.57E+00	2.55E+00	1.069	
9	8.81E-04	2.43E+00	2.44E+00	-0.692	
10	1.10E-03	2.35E+00	2.36E+00	-0.121	
11	1.41E-03	2.29E+00	2.28E+00	0.274	
12	1.80E-03	2.23E+00	2.22E+00	0.656	
13	2.21E-03	2.15E+00	2.15E+00	-0.037	
14	2.83E-03	2.10E+00	2.10E+00	-0.088	
15	3.57E-03	2.04E+00	2.02E+00	0.761	
16	4.43E-03	1.94E+00	1.96E+00	-1.073	
17	5.64E-03	1.88E+00	1.89E+00	-0.307	
18	7.13E-03	1.83E+00	1.81E+00	0.908	
19	8.81E-03	1.80E+00	1.78E+00	1.022	
20	1.10E-02	1.74E+00	1.76E+00	-0.856	
21	1.41E-02	1.76E+00	1.76E+00	-0.086	
22	1.80E-02	1.77E+00	1.79E+00	-1.117	
23	2.22E-02	1.85E+00	1.84E+00	0.116	
24	2.85E-02	1.97E+00	1.95E+00	0.961	
25	3.60E-02	2.05E+00	2.05E+00	0.245	
26	4.49E-02	2.20E+00	2.21E+00	-0.431	

R: 23. X: 0. Y: 23. DL: 46. REQ: 26. CF: 1.0000
CLHZ ARRAY, 26 DATA POINTS, RAMP: 55.0 MICROSEC, DATA: 000-000
MOLOKAI TEST

RMS LOG ERROR: 4.87E-03, ANTILOG YIELDS 1.1280 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.71
P 2 0.00 1.00
P 3 -0.01 0.00 0.92
P 4 0.05 0.00 -0.02 0.15
T 1 0.02 0.01 0.00 -0.01 0.95
T 2 0.01 0.01 0.12 -0.03 -0.03 0.70


00-01
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
7.83
OHM-M
18.5 M
201.
OHM-M
63.7 M
2.12
OHM-M
35.4 M
7.27
OHM-M
199. M
14.1
OHM-M
% ERROR: 1.78
CALIBRATION: 1
OFFSET: 61.0 M
RAMP: 50.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		67.1	220.0		
7.53	18.5	48.6	159.4	2.4	2.4
200.64	63.7	-15.1	-49.5	0.3	2.7
2.19	35.4	-50.5	-165.7	16.2	18.9
7.08					
32.08					

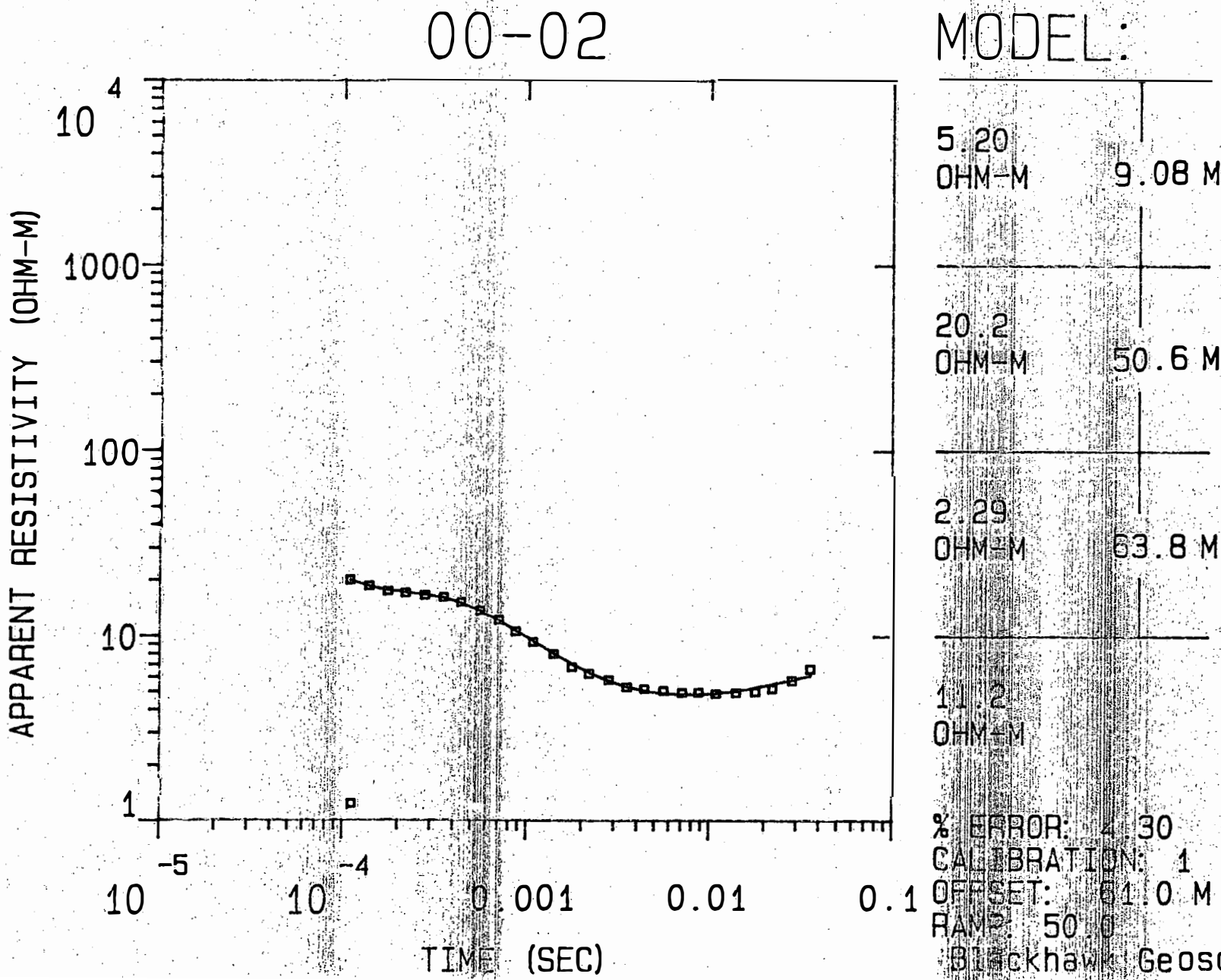
	TIMES	DATA	CALC	%ERROR	STD ERR
1	1.25E-04	2.31E+01	2.32E+01	-0.433	
2	1.74E-04	2.26E+01	2.27E+01	-0.442	
3	2.20E-04	2.19E+01	2.17E+01	0.730	
4	2.80E-04	2.25E+01	2.27E+01	-0.886	
5	3.55E-04	2.35E+01	2.34E+01	0.438	
6	4.43E-04	2.32E+01	2.31E+01	0.285	
7	5.64E-04	2.14E+01	2.15E+01	-0.730	
8	7.13E-04	1.91E+01	1.90E+01	0.602	
9	8.81E-04	1.64E+01	1.65E+01	-0.587	
10	1.10E-03	1.43E+01	1.42E+01	0.595	
11	1.41E-03	1.21E+01	1.20E+01	0.800	
12	1.78E-03	1.04E+01	1.05E+01	-1.323	
13	2.21E-03	9.45E+00	9.47E+00	-0.207	
14	2.83E-03	8.79E+00	8.58E+00	2.527	
15	3.55E-03	7.78E+00	7.96E+00	-2.260	
16	4.43E-03	7.45E+00	7.52E+00	-0.950	
17	5.64E-03	7.18E+00	7.17E+00	0.017	
18	7.13E-03	7.12E+00	6.94E+00	2.593	
19	8.81E-03	6.75E+00	6.80E+00	-0.754	
20	1.10E-02	6.68E+00	6.73E+00	-0.795	
21	1.41E-02	6.67E+00	6.72E+00	-0.696	
22	1.80E-02	6.72E+00	6.85E+00	-1.935	
23	2.22E-02	7.08E+00	6.92E+00	2.237	

R: 61. X: 0. Y: 61. DL: 122. REQ: 68. CF: 1.0000
CLAZ ARRAY, 23 DATA POINTS, RAMP: 50.0 MICROSEC, DATA: 00-01

RMS LOG ERROR: 7.67E-03, ANTILOG YIELDS 1.7310 %
LATE TIME PARAMETERS

Blackhawk Geosciences

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.99
P 2 -0.02 0.01
P 3 0.03 0.00 0.80
P 4 -0.02 0.00 -0.07 0.93
P 5 0.00 -0.01 -0.01 -0.01 0.96
T 1 -0.02 -0.62 -0.15 0.02 0.00 0.92
T 2 0.00 0.02 0.00 0.01 0.00 -0.01 1.00
T 3 0.05 0.00 -0.19 -0.10 -0.03 0.03 0.03 0.85
T 4 0.01 -0.01 -0.02 -0.12 -0.01 0.02 0.01 -0.15 0.49


00-02
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
5.20
OHM-M
9.08 M
20.2
OHM-M
50.6 M
2.29
OHM-M
63.8 M
11.2
OHM-M
% ERROR: 4 30
CALIBRATION: 1
OFFSET: 61 0 M
RAMP: 50 0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		60.0	197.0		
5.20	9.1	51.0	167.2	1.7	1.7
20.24	50.6	0.4	1.2	2.5	4.2
2.29	63.8	-63.4	-208.1	27.9	32.1
11.15					

	TIMES	DATA	CALC	ERROR	STD DEV
1	1.10E-04	2.02E+01	2.02E+01	-0.038	
2	1.41E-04	1.94E+01	1.93E+01	0.464	
3	1.77E-04	1.75E+01	1.77E+01	-1.143	
4	2.20E-04	1.72E+01	1.73E+01	-0.581	
5	2.80E-04	1.66E+01	1.67E+01	-0.696	
6	3.55E-04	1.62E+01	1.60E+01	1.094	
7	4.43E-04	1.52E+01	1.50E+01	1.348	
8	5.64E-04	1.37E+01	1.36E+01	0.780	
9	7.13E-04	1.22E+01	1.21E+01	1.086	
10	8.81E-04	1.06E+01	1.07E+01	-0.901	
11	1.10E-03	9.27E+00	9.35E+00	-0.784	
12	1.41E-03	7.98E+00	8.02E+00	-0.464	
13	1.78E-03	6.78E+00	7.02E+00	-3.436	
14	2.21E-03	6.24E+00	6.30E+00	-0.950	
15	2.83E-03	5.78E+00	5.70E+00	1.450	
16	3.55E-03	5.30E+00	5.30E+00	-0.137	
17	4.43E-03	5.19E+00	5.05E+00	2.843	
18	5.64E-03	5.07E+00	4.89E+00	3.810	
19	7.13E-03	4.95E+00	4.83E+00	2.558	
20	8.81E-03	4.97E+00	4.85E+00	2.577	
21	1.10E-02	4.89E+00	4.93E+00	-0.784	
22	1.41E-02	4.94E+00	5.09E+00	-3.052	
23	1.80E-02	5.00E+00	5.30E+00	-5.201	
24	2.22E-02	5.22E+00	5.53E+00	-5.922	
25	2.85E-02	5.78E+00	5.83E+00	-0.973	
26	3.60E-02	6.67E+00	6.15E+00	8.431	

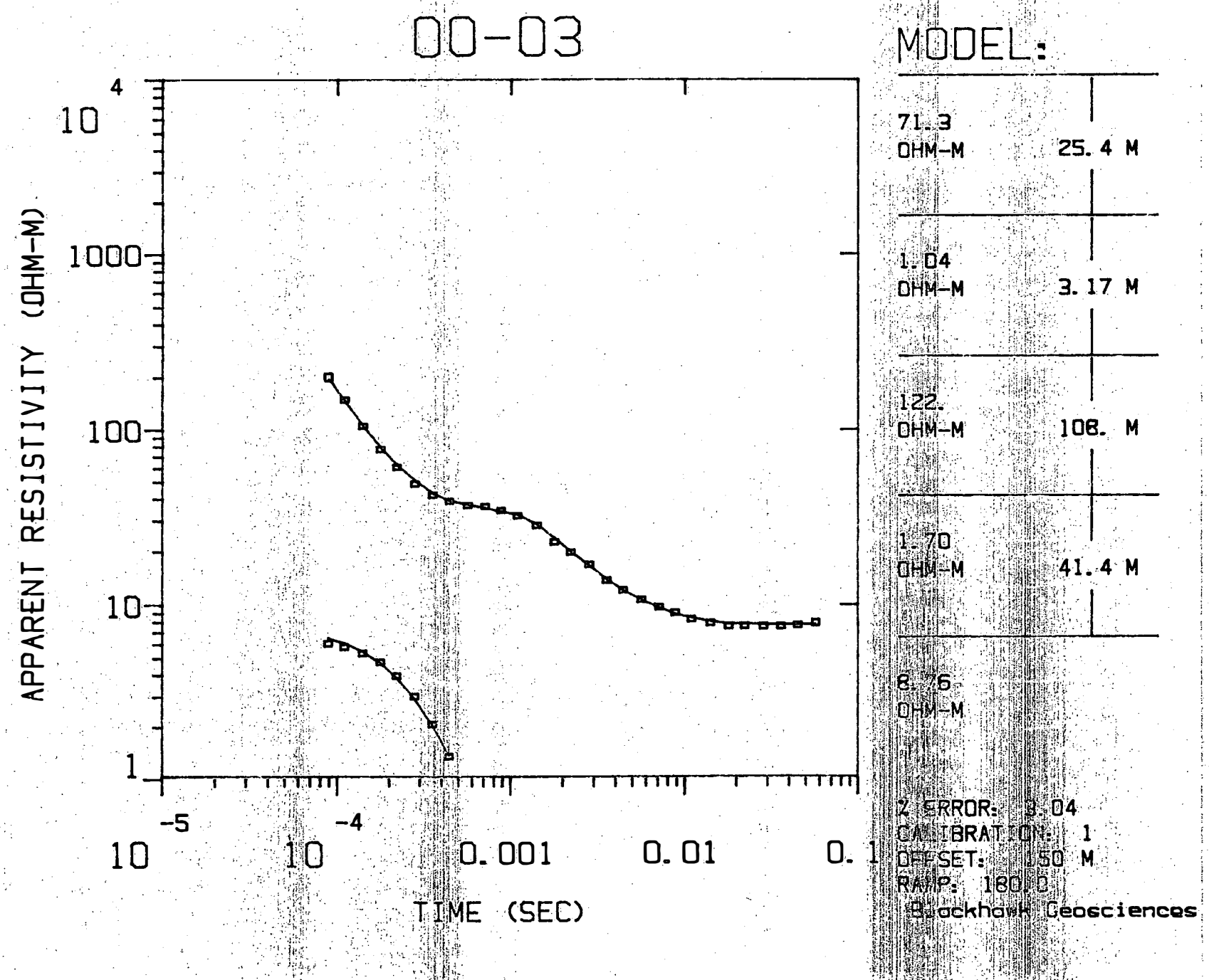
R: 61. X: 0. Y: 61. DL: 122. REQ: 68. CF: 1.0000
CLHZ ARRAY, 26 DATA POINTS, RANP: 50.0 MICROSEC, DATA: 00-02

RMS LOG ERROR: 1.83E-02, ANTILOG YIELDS 4.2977 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

```
P 1  0.80
P 2 -0.01  0.61
P 3  0.03 -0.05  0.95
P 4 -0.01 -0.03 -0.03  0.58
T 1 -0.51 -0.28  0.01  0.00  0.32
T 2  0.04  0.12  0.02  0.01  0.14  0.95
T 3  0.04 -0.10 -0.05 -0.10  0.00  0.04  0.84
```


00-03
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
MODEL:
71.3
OHM-M
25.4 M
1.04
OHM-M
3.17 M
122.
OHM-M
108. M
1.70
OHM-M
41.4 M
8.76
OHM-M
% ERROR: 3.04
CALIBRATION: 1
OFFSET: 150 M
RAMP: 1800
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		95.1	312.0		
71.28	25.4	69.7	228.6	0.4	0.4
1.04	3.2	66.5	218.2	3.0	3.4
122.16	106.1	-41.5	-136.2	0.9	4.3
1.70	41.4	-82.9			

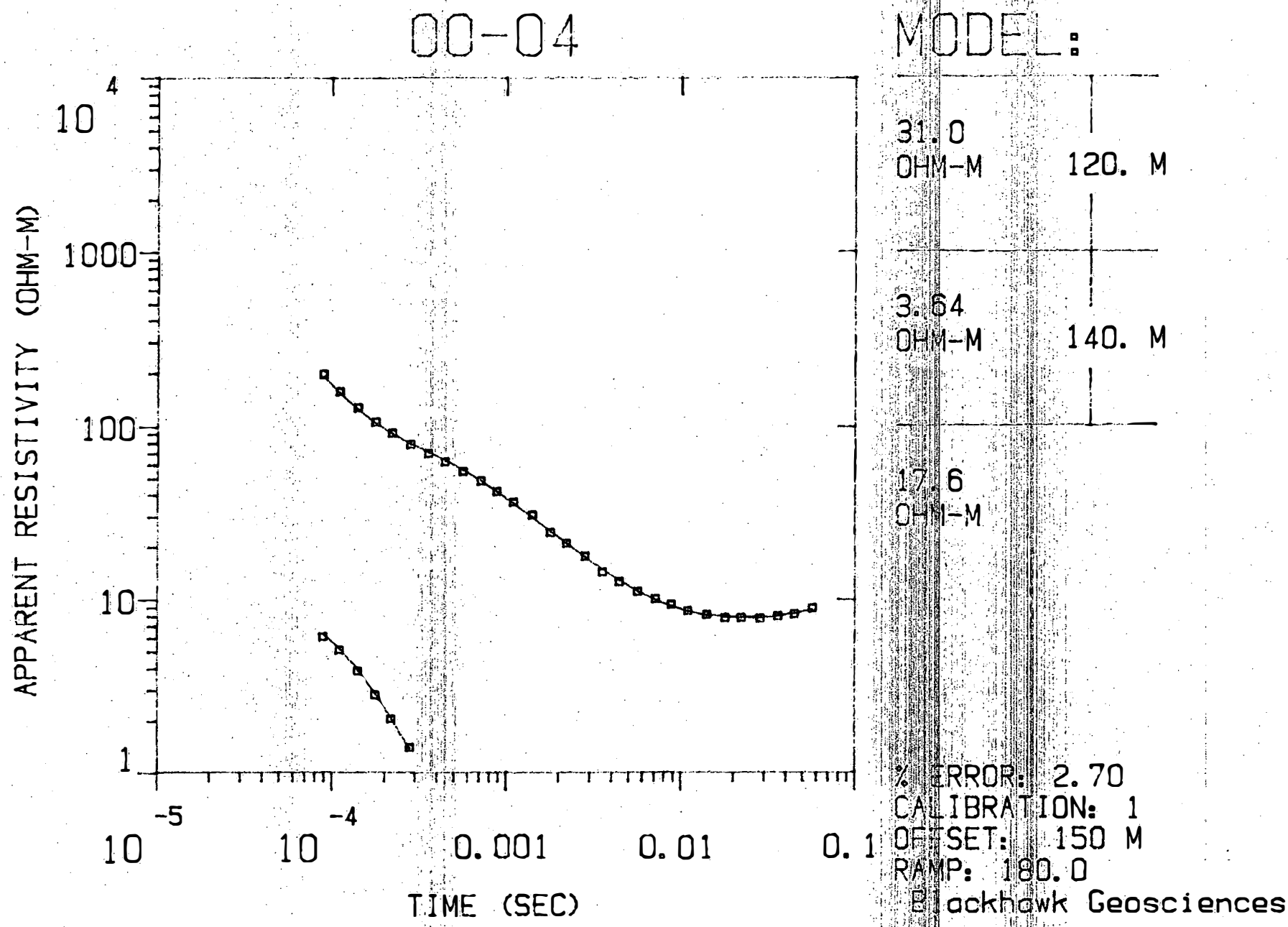
	TIMES	DATA	CALC	% ERROR	STD ERR
2	1.10E-04	9.44E+01	9.44E+01	0.000	
3	1.40E-04	1.05E+01	1.00E+01	4.761	
4	1.77E-04	7.53E+01	7.66E+01	-1.664	
5	2.20E-04	5.92E+01	6.07E+01	-2.889	
6	2.80E-04	4.75E+01	4.90E+01	-2.948	
7	3.55E-04	4.09E+01	4.16E+01	-1.560	
8	4.48E-04	3.77E+01	3.76E+01	0.177	
9	5.64E-04	3.57E+01	3.57E+01	0.098	
10	7.13E-04	3.52E+01	3.41E+01	3.254	
11	8.81E-04	3.34E+01	3.24E+01	2.865	
12	1.10E-03	3.11E+01	3.12E+01	-0.359	
13	1.41E-03	2.74E+01	2.76E+01	-0.872	
14	1.78E-03	2.21E+01	2.30E+01	-4.249	
15	2.21E-03	1.93E+01	1.93E+01	-0.071	
16	2.83E-03	1.65E+01	1.61E+01	2.304	
17	3.55E-03	1.34E+01	1.35E+01	-0.715	
18	4.48E-03	1.18E+01	1.17E+01	1.400	
19	5.64E-03	1.05E+01	1.03E+01	1.324	
20	7.13E-03	9.50E+00	9.34E+00	1.755	
21	8.81E-03	8.84E+00	8.63E+00	2.409	
22	1.10E-02	8.14E+00	8.23E+00	-1.173	
23	1.41E-02	7.75E+00	7.85E+00	-1.282	
24	1.80E-02	7.43E+00	7.59E+00	-2.170	
25	2.22E-02	7.44E+00	7.56E+00	-1.609	
26	2.85E-02	7.40E+00	7.47E+00	-0.946	
27	3.60E-02	7.39E+00	7.46E+00	-0.891	
28	4.49E-02	7.53E+00	7.53E+00	0.062	
29	5.70E-02	7.48E+00	7.59E+00	-1.362	

R: 150. X: 0. Y: 150. OL: 300. RHO: 167. DF: 1.0000
CLHZ ARRAY: 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-02

RMS LOG ERROR: 1.30E-02, ANTILOG YIELDS 3.043) %
LATE TIME PARAMETERS

Blackhawk Geosciences

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.15
P 2 0.4 0.37
P 3 0.00 0.01 0.00


00-04
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
31.0
OHM-M
120. M
3.64
OHM-M
140. M
17.6
OHM-M
% ERROR: 2.70
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		-121.0	397.0		
30.97	119.7	1.3	4.4	3.9	3.9
3.64	140.3	-139.0	-455.9	38.5	42.4
17.63					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.98E+02	1.92E+02	2.952	
2	1.10E-04	1.57E+02	1.54E+02	1.910	
3	1.40E-04	1.26E+02	1.23E+02	1.410	
4	1.77E-04	1.05E+02	1.03E+02	1.500	
5	2.20E-04	9.04E+01	8.98E+01	0.771	
6	2.80E-04	7.79E+01	7.89E+01	-1.194	
7	3.55E-04	6.92E+01	7.04E+01	-1.771	
8	4.43E-04	6.20E+01	6.33E+01	-2.126	
9	5.64E-04	5.44E+01	5.57E+01	-2.236	
10	7.13E-04	4.81E+01	4.82E+01	-0.227	
11	8.81E-04	4.17E+01	4.17E+01	0.190	
12	1.10E-03	3.62E+01	3.55E+01	1.899	
13	1.41E-03	3.04E+01	2.93E+01	3.577	
14	1.78E-03	2.41E+01	2.45E+01	-1.912	
15	2.21E-03	2.08E+01	2.08E+01	-0.138	
16	2.83E-03	1.76E+01	1.74E+01	1.267	
17	3.55E-03	1.43E+01	1.48E+01	-3.332	
18	4.43E-03	1.25E+01	1.27E+01	-1.734	
19	5.64E-03	1.10E+01	1.11E+01	-0.245	
20	7.13E-03	9.98E+00	9.85E+00	1.323	
21	8.81E-03	9.27E+00	9.05E+00	2.340	
22	1.10E-02	8.51E+00	8.47E+00	0.468	
23	1.41E-02	8.11E+00	8.05E+00	0.736	
24	1.80E-02	7.77E+00	7.84E+00	-0.919	
25	2.22E-02	7.78E+00	7.79E+00	-0.064	
26	2.85E-02	7.74E+00	7.86E+00	-1.496	
27	3.60E-02	7.96E+00	8.05E+00	-1.034	
28	4.49E-02	8.18E+00	8.31E+00	-1.560	
29	5.70E-02	8.90E+00	8.68E+00	2.543	

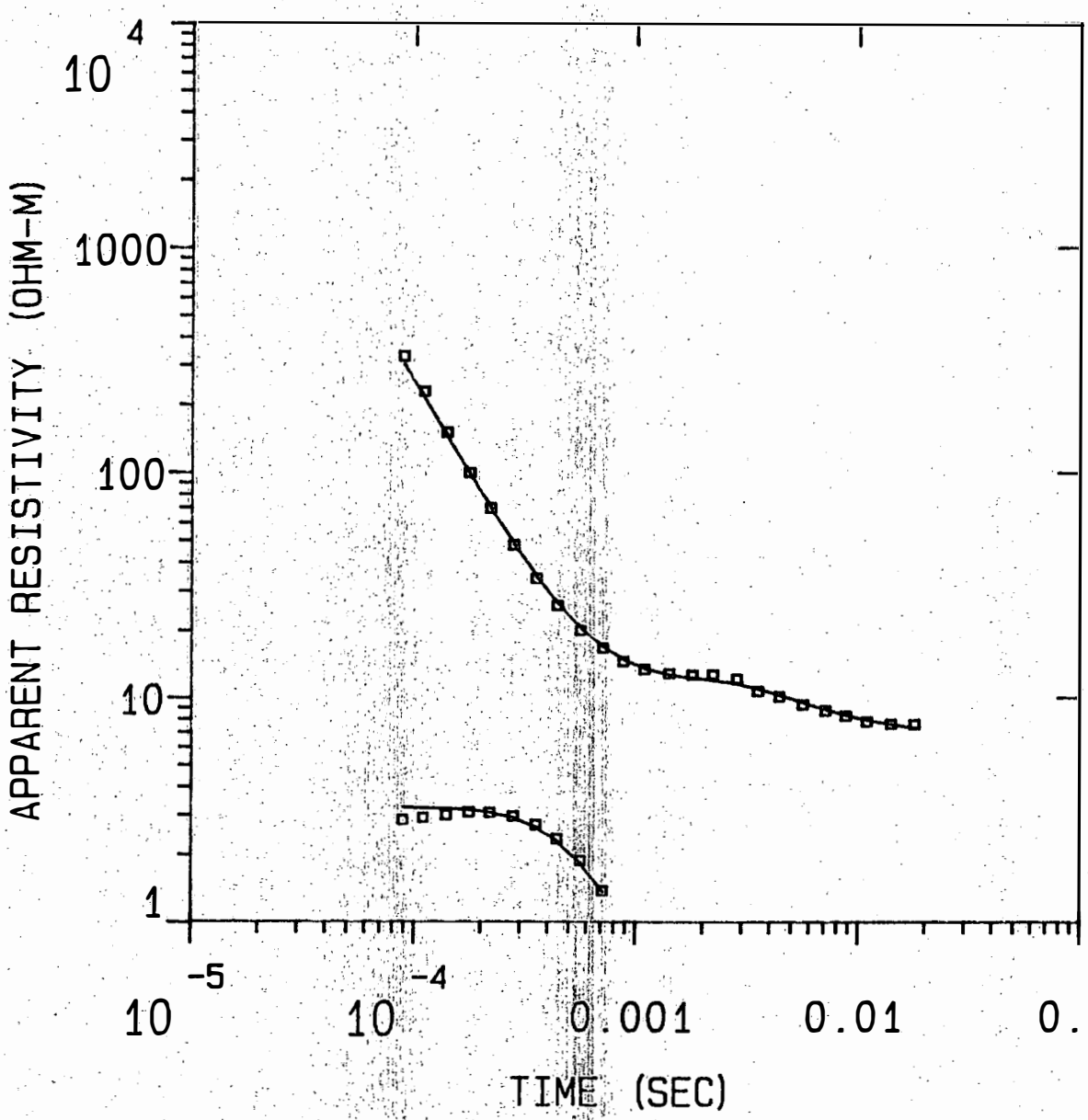
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-04

RMS LOG ERROR: 1.16E-02, ANTILOG YIELDS 2.6930 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 1.00
P 2 0.00 0.98
P 3 0.00 -0.02 0.60
T 1 0.00 0.00 0.01 1.00

00-05



MODEL:

449. OHM-M	16.8 M
3.21 OHM-M	29.2 M
120. OHM-M	93.1 M
3.00 OHM-M	66.9 M
6.99 OHM-M	

% ERROR: 5.08
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		114.9	377.0		
448.93	16.8	98.1	321.9	0.0	0.0
3.21	29.2	69.0	226.2	9.1	9.1
120.07	93.1	-24.2	-79.4	0.8	9.9
3.00	66.9	-91.1			
6.99					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	3.28E+02	3.02E+02	8.037	
2	1.10E-04	2.28E+02	2.13E+02	6.662	
3	1.40E-04	1.50E+02	1.43E+02	4.232	
4	1.77E-04	9.92E+01	9.79E+01	1.343	
5	2.20E-04	6.92E+01	6.93E+01	-0.150	
6	2.80E-04	4.75E+01	4.81E+01	-1.303	
7	3.55E-04	3.39E+01	3.46E+01	-2.062	
8	4.43E-04	2.57E+01	2.63E+01	-2.019	
9	5.64E-04	2.00E+01	2.04E+01	-2.146	
10	7.13E-04	1.66E+01	1.68E+01	-1.123	
11	8.81E-04	1.45E+01	1.47E+01	-1.610	
12	1.10E-03	1.33E+01	1.34E+01	-0.563	
13	1.41E-03	1.27E+01	1.25E+01	1.689	
14	1.80E-03	1.26E+01	1.21E+01	3.849	
15	2.22E-03	1.26E+01	1.18E+01	6.562	
16	2.85E-03	1.20E+01	1.14E+01	5.464	
17	3.55E-03	1.06E+01	1.09E+01	-2.011	
18	4.43E-03	1.00E+01	1.02E+01	-1.427	
19	5.64E-03	9.23E+00	9.42E+00	-1.998	
20	7.13E-03	8.69E+00	8.77E+00	-0.886	
21	8.81E-03	8.24E+00	8.28E+00	-0.559	
22	1.10E-02	7.77E+00	7.88E+00	-1.406	
23	1.41E-02	7.59E+00	7.53E+00	0.837	
24	1.80E-02	7.57E+00	7.29E+00	3.833	

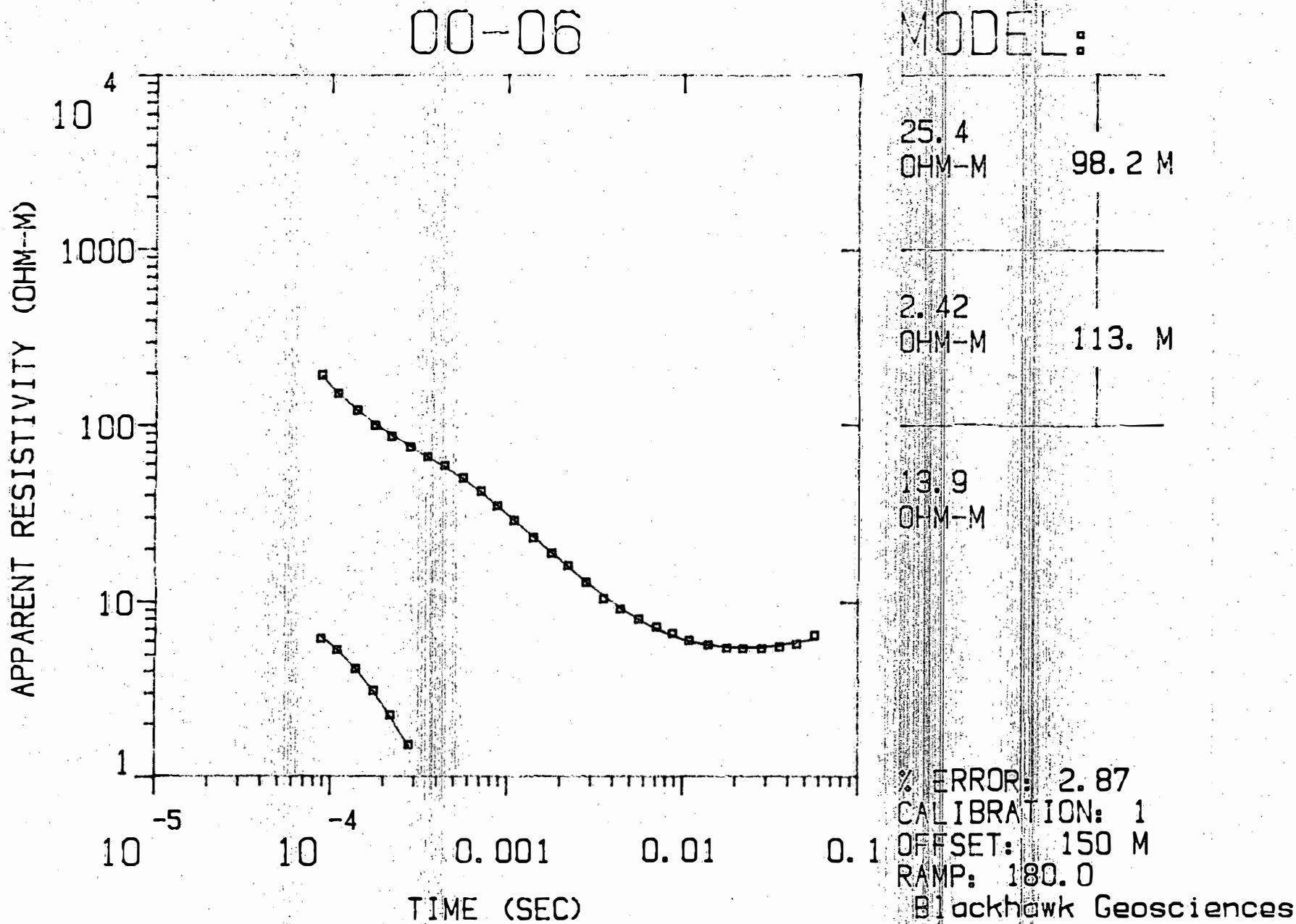
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 24 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-05

RMS LOG ERROR: 2.15E-02, ANTILOG YIELDS 5.0826 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.00					
P 2	0.00	0.65				
P 3	0.00	0.01	0.00			
P 4	0.00	0.01	0.01	0.39		
P 5	0.00	0.00	0.00	0.11	0.08	
T 1	0.00	0.19	0.00	0.01	-0.01	0.47
T 2	0.00	-0.39	-0.01	0.06	0.01	0.15	0.46


00-06
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
25.4
OHM-M
98.2 M
2.42
OHM-M
113. M
13.9
OHM-M
% ERROR: 2.87
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL : 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		75.0	246.0		
25.42	98.2	-23.2	-76.1	3.9	3.9
2.42	112.9	-136.1	-446.4	46.7	50.6
13.89					

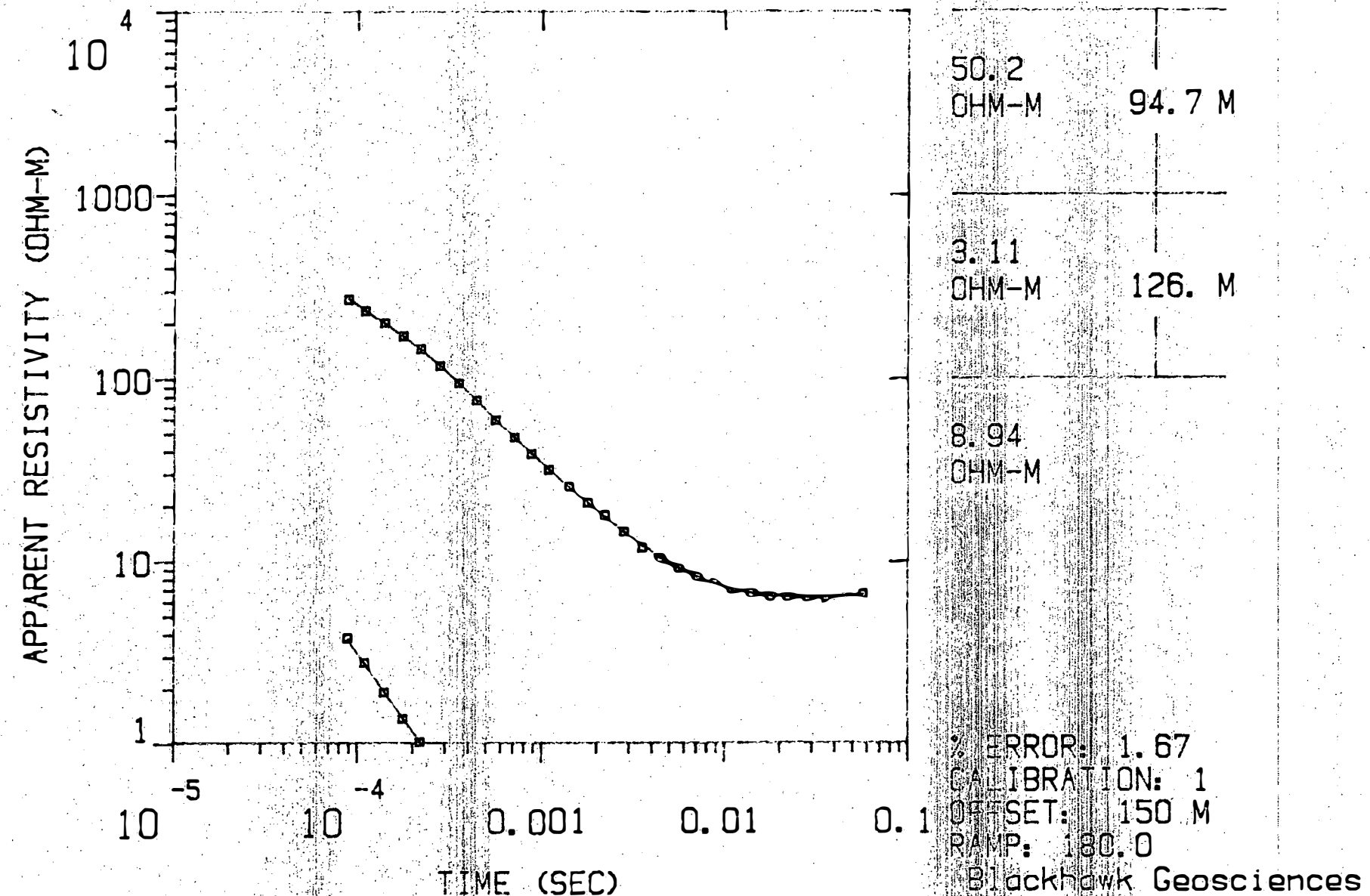
	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.96E+02	1.92E+02	2.069	
2	1.10E-04	2.52E+02	1.92E+02	1.717	
3	1.40E-04	1.21E+02	1.24E+02	-2.560	
4	1.77E-04	9.90E+01	1.00E+02	-0.992	
5	2.20E-04	8.53E+01	8.64E+01	-1.215	
6	2.80E-04	7.40E+01	7.51E+01	-1.435	
7	3.55E-04	6.62E+01	6.59E+01	0.339	
8	4.43E-04	5.88E+01	5.79E+01	1.481	
9	5.64E-04	5.00E+01	4.93E+01	1.406	
10	7.13E-04	4.20E+01	4.13E+01	1.690	
11	8.81E-04	3.47E+01	3.48E+01	-0.072	
12	1.10E-03	2.87E+01	2.89E+01	-0.597	
13	1.41E-03	2.31E+01	2.33E+01	-0.852	
14	1.80E-03	1.88E+01	1.90E+01	-0.592	
15	2.22E-03	1.60E+01	1.58E+01	1.317	
16	2.83E-03	1.29E+01	1.30E+01	-0.900	
17	3.55E-03	1.04E+01	1.08E+01	-4.175	
18	4.43E-03	9.10E+00	9.23E+00	-1.412	
19	5.64E-03	8.00E+00	7.91E+00	1.035	
20	7.13E-03	7.19E+00	6.98E+00	3.008	
21	8.81E-03	6.61E+00	6.38E+00	3.483	
22	1.10E-02	6.03E+00	5.95E+00	1.449	
23	1.41E-02	5.67E+00	5.63E+00	0.688	
24	1.80E-02	5.43E+00	5.48E+00	-0.959	
25	2.22E-02	5.40E+00	5.45E+00	-1.019	
26	2.85E-02	5.41E+00	5.52E+00	-2.016	
27	3.60E-02	5.54E+00	5.67E+00	-2.348	
28	4.49E-02	5.76E+00	5.89E+00	-2.108	
29	5.70E-02	6.49E+00	6.19E+00	4.896	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-06

RMS LOG ERROR: 1.23E-02, ANTILOG YIELDS 2.8693 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 1.00
P 2 0.00 0.99
P 3 0.00 -0.02 0.61
P 4 0.00 0.00 0.00 1.00


00-07
MODEL:
50.2
OHM-M
94.7 M
3.11
OHM-M
126. M
8.94
OHM-M
% ERROR: 1.67
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		71.9	236.0		
50.23	94.7	-22.8	-74.8	1.9	1.9
3.11	125.8	-148.6	-487.6	40.5	42.4
8.94					

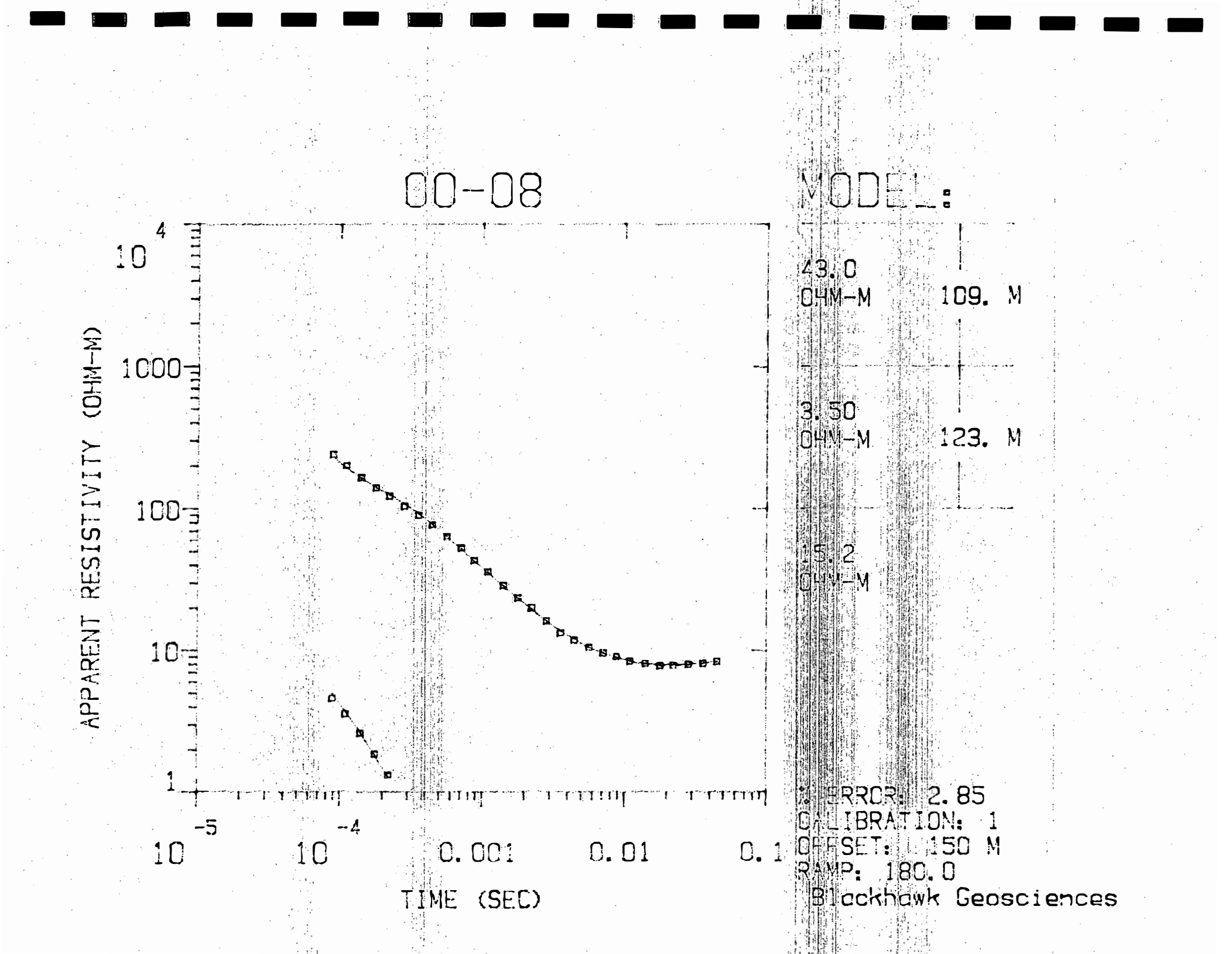
	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.70E+02	2.74E+02	-1.450	
2	1.11E-04	2.45E+02	2.45E+02	-0.000	
3	1.40E-04	2.01E+02	1.98E+02	1.465	
4	1.77E-04	1.70E+02	1.69E+02	0.575	
5	2.20E-04	1.45E+02	1.44E+02	0.564	
6	2.80E-04	1.17E+02	1.17E+02	-0.358	
7	3.55E-04	9.41E+01	9.41E+01	-0.034	
8	4.43E-04	7.61E+01	7.59E+01	0.303	
9	5.64E-04	5.95E+01	5.97E+01	-0.386	
10	7.13E-04	4.74E+01	4.75E+01	-0.044	
11	8.81E-04	3.85E+01	3.88E+01	-0.721	
12	1.10E-03	3.14E+01	3.17E+01	-0.786	
13	1.41E-03	2.53E+01	2.53E+01	0.174	
14	1.80E-03	2.07E+01	2.06E+01	0.738	
15	2.22E-03	1.77E+01	1.73E+01	2.868	
16	2.83E-03	1.44E+01	1.43E+01	0.412	
17	3.55E-03	1.17E+01	1.21E+01	-3.390	
18	4.43E-03	1.04E+01	1.05E+01	-1.328	
19	5.64E-03	9.14E+00	9.14E+00	0.000	
20	7.13E-03	8.26E+00	8.17E+00	1.134	
21	8.81E-03	7.67E+00	7.52E+00	1.948	
22	1.10E-02	7.03E+00	7.04E+00	-0.145	
23	1.41E-02	6.67E+00	6.66E+00	0.070	
24	1.80E-02	6.39E+00	6.44E+00	-0.865	
25	2.22E-02	6.33E+00	6.34E+00	-0.055	
26	2.85E-02	6.29E+00	6.30E+00	-0.236	
27	3.60E-02	6.27E+00	6.33E+00	-1.040	
28	4.49E-02	6.45E+00	6.41E+00	0.610	
29	5.70E-02	6.55E+00	6.52E+00	0.435	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-07

RMS LOG ERROR: 7.19E-03, ANTILOG YIELDS 1.6695 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 1.00
P 2 0.00 0.99
P 3 0.00 -0.01 0.78
T 1 0.00 0.00 0.00 1.00


00-08
MODEL:
43.0
OHM-M
109. M
3.50
OHM-M
123. M
5.2
OHM-M
% ERROR: 2.85
CALIBRATION: 1
OFFSET: 0.150 M
RAMP: 180.0
Blackhawk Geosciences
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		94.8	311.0		
43.00	108.5	-13.7	-45.0	2.5	2.5
8.50	122.9	-136.7	-448.3	35.1	37.7
15.18					

	TIMES	DATA	CALC	% ERROR
1	8.90E-05	2.40E+02	2.29E+02	4.45
2	1.10E-04	1.99E+02	1.92E+02	3.44
3	1.40E-04	1.60E+02	1.55E+02	3.08
4	1.77E-04	1.39E+02	1.40E+02	-0.783
5	2.20E-04	1.21E+02	1.24E+02	-2.132
6	2.80E-04	1.03E+02	1.07E+02	-3.808
7	3.55E-04	8.92E+01	9.17E+01	-2.714
8	4.43E-04	7.67E+01	7.76E+01	-1.100
9	5.64E-04	6.36E+01	6.35E+01	0.179
10	7.13E-04	5.26E+01	5.17E+01	1.688
11	8.81E-04	4.34E+01	4.29E+01	1.203
12	1.10E-03	3.57E+01	3.54E+01	0.771
13	1.41E-03	2.87E+01	2.85E+01	0.795
14	1.80E-03	2.34E+01	2.33E+01	0.648
15	2.22E-03	1.99E+01	1.95E+01	2.141
16	2.83E-03	1.62E+01	1.62E+01	-0.153
17	3.55E-03	1.32E+01	1.37E+01	-3.723
18	4.43E-03	1.17E+01	1.19E+01	-1.730
19	5.64E-03	1.04E+01	1.04E+01	-0.342
20	7.13E-03	9.51E+00	9.41E+00	1.048
21	8.81E-03	8.92E+00	8.75E+00	1.925
22	1.10E-02	8.28E+00	8.29E+00	-0.109
23	1.41E-02	7.98E+00	7.97E+00	0.187
24	1.80E-02	7.76E+00	7.83E+00	-0.977
25	2.22E-02	7.81E+00	7.83E+00	-0.320
26	2.85E-02	7.92E+00	7.94E+00	-0.257
27	3.60E-02	8.13E+00	8.15E+00	-0.203
28	4.49E-02	8.43E+00	8.41E+00	0.251

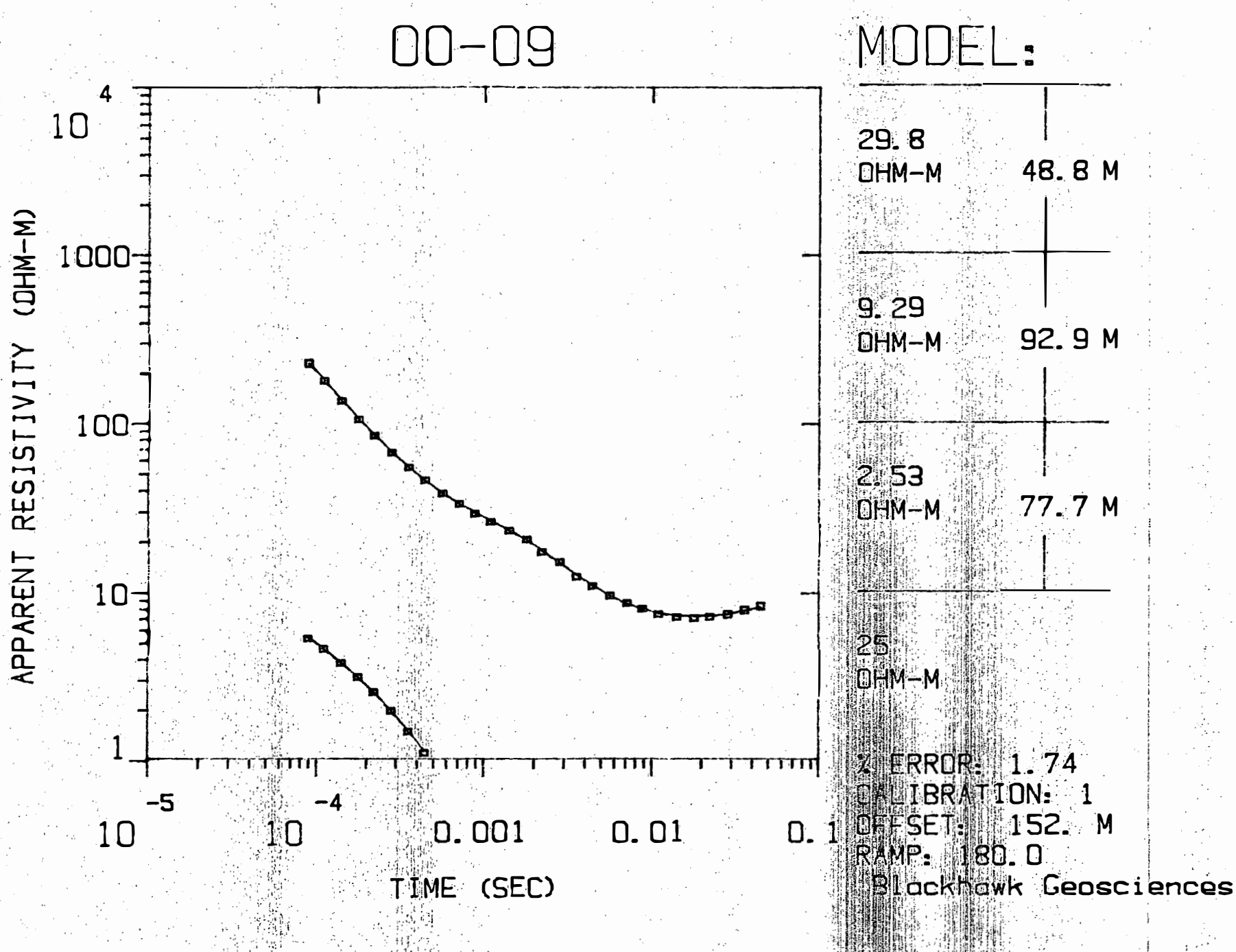
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 28 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-08

RMS LOG ERROR: 1.22E-02. ANTILOG YIELDS 2.8522 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

```
P 1  1.00
P 2  0.00  0.99
P 3  0.00 -0.02  0.60
T 1  0.00  0.00  0.00  1.00
T 2  0.00  0.00  0.14  0.01  0.01
```


00-09
MODEL:
29.8
OHM-M
48.8 M
9.29
OHM-M
92.9 M
2.53
OHM-M
77.7 M
25
OHM-M
% ERROR: 1.74
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
Blackhawk Geosciences
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		110.0	361.0		
29.79	48.8	61.2	200.7	1.6	1.6
9.29	92.9	-31.7	-104.1	10.0	11.6
2.53	77.7	-109.4	-359.1	30.8	42.4
25.00					

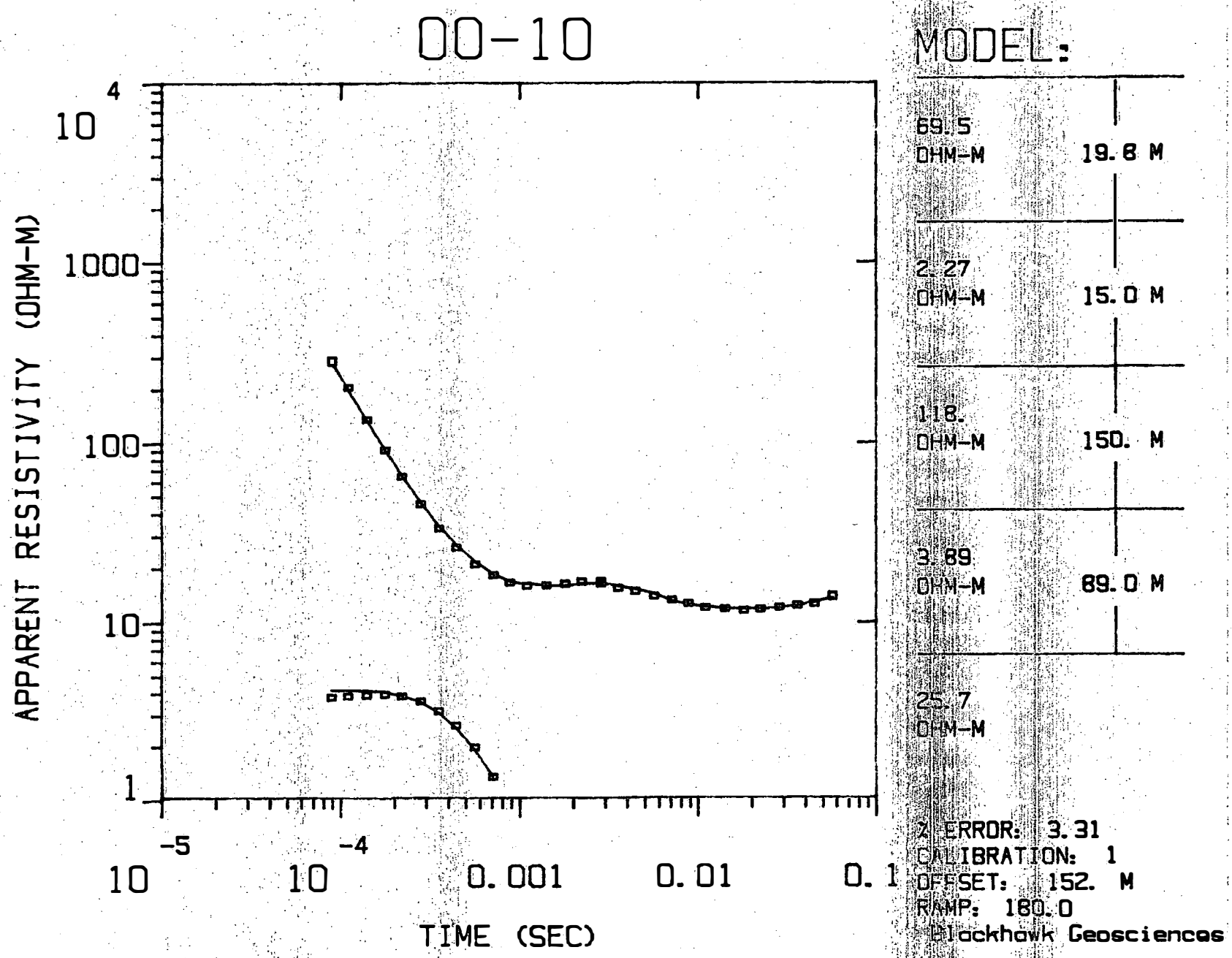
	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.30E+02	2.29E+02	0.600	
2	1.12E-04	1.77E+02	1.78E+02	-0.4	
3	1.40E-04	1.35E+02	1.36E+02	-0.764	
4	1.77E-04	1.04E+02	1.05E+02	-0.780	
5	2.20E-04	8.32E+01	8.36E+01	-0.392	
6	2.80E-04	6.59E+01	6.61E+01	-0.302	
7	3.55E-04	5.37E+01	5.34E+01	0.470	
8	4.43E-04	4.50E+01	4.45E+01	1.197	
9	5.64E-04	3.77E+01	3.75E+01	0.546	
10	7.13E-04	3.27E+01	3.26E+01	0.326	
11	8.81E-04	2.86E+01	2.90E+01	-1.272	
12	1.10E-03	2.57E+01	2.58E+01	-0.554	
13	1.41E-03	2.28E+01	2.28E+01	-0.041	
14	1.80E-03	2.02E+01	1.99E+01	1.405	
15	2.21E-03	1.71E+01	1.73E+01	-1.385	
16	2.83E-03	1.49E+01	1.47E+01	1.792	
17	3.55E-03	1.22E+01	1.25E+01	-2.154	
18	4.43E-03	1.08E+01	1.08E+01	-0.142	
19	5.64E-03	9.47E+00	9.38E+00	0.918	
20	7.13E-03	8.56E+00	8.42E+00	1.607	
21	8.81E-03	7.94E+00	7.87E+00	0.892	
22	1.10E-02	7.35E+00	7.40E+00	-0.729	
23	1.41E-02	7.06E+00	7.14E+00	-1.115	
24	1.80E-02	6.94E+00	7.15E+00	-2.974	
25	2.22E-02	7.12E+00	7.15E+00	-0.424	
26	2.85E-02	7.42E+00	7.43E+00	-0.158	
27	3.60E-02	7.88E+00	7.80E+00	1.038	
28	4.49E-02	8.36E+00	8.20E+00	1.926	

R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 28 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-09

RMS LOG ERROR: 7.50E-03, ANTILOG YIELDS 1.7418 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.98
P 2 -0.02 0.97
P 3 -0.01 -0.02 0.90
F 4 0.00 0.00 0.00 0.00
T 1 0.03 0.03 0.02 0.00 0.96


00-10
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
MODEL:
69.5
OHM-M
19.8 M
2.27
OHM-M
15.0 M
118.
OHM-M
150. M
3.89
OHM-M
89.0 M
25.7
OHM-M
% ERROR: 3.31
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		139.9	459.0		
69.48	19.8	120.1	394.1	0.3	0.3
2.27	15.0	105.1	344.8	6.6	6.9
117.69	150.1	-45.0	-147.6	1.3	8.2
3.89	89.0	-134.0	-439.5	22.9	31.0
25.70					

	TIMES	DATA	CALC	% ERROR	TO ERR
1	9.90E-05	2.02E+02	2.02E+02	0.000	
2	1.10E-04	2.01E+02	1.93E+02	4.200	
3	1.40E-04	1.33E+02	1.30E+02	2.778	
4	1.77E-04	8.94E+01	8.88E+01	0.691	
5	2.20E-04	6.32E+01	6.34E+01	-0.374	
6	2.80E-04	4.42E+01	4.48E+01	-1.430	
7	3.55E-04	3.24E+01	3.31E+01	-2.187	
8	4.43E-04	2.54E+01	2.61E+01	-2.613	
9	5.64E-04	2.05E+01	2.11E+01	-2.611	
10	7.13E-04	1.79E+01	1.80E+01	-0.453	
11	8.81E-04	1.63E+01	1.64E+01	-0.400	
12	1.10E-03	1.57E+01	1.58E+01	-1.025	
13	1.41E-03	1.58E+01	1.54E+01	1.996	
14	1.80E-03	1.61E+01	1.55E+01	4.368	
15	2.22E-03	1.66E+01	1.63E+01	1.870	
16	2.85E-03	1.67E+01	1.62E+01	3.222	
17	2.85E-03	1.61E+01	1.62E+01	-0.081	
18	3.55E-03	1.52E+01	1.55E+01	-2.009	
19	4.43E-03	1.46E+01	1.49E+01	-1.782	
20	5.64E-03	1.37E+01	1.40E+01	-2.331	
21	7.13E-03	1.30E+01	1.27E+01	2.370	
22	8.81E-03	1.25E+01	1.22E+01	2.055	
23	1.10E-02	1.18E+01	1.18E+01	0.041	
24	1.41E-02	1.16E+01	1.15E+01	1.240	
25	1.80E-02	1.14E+01	1.15E+01	-0.263	
26	2.22E-02	1.16E+01	1.16E+01	-0.047	
27	2.85E-02	1.19E+01	1.20E+01	-0.394	
28	3.60E-02	1.23E+01	1.23E+01	-0.200	
29	4.49E-02	1.26E+01	1.29E+01	-2.344	
30	5.70E-02	1.39E+01	1.36E+01	2.548	

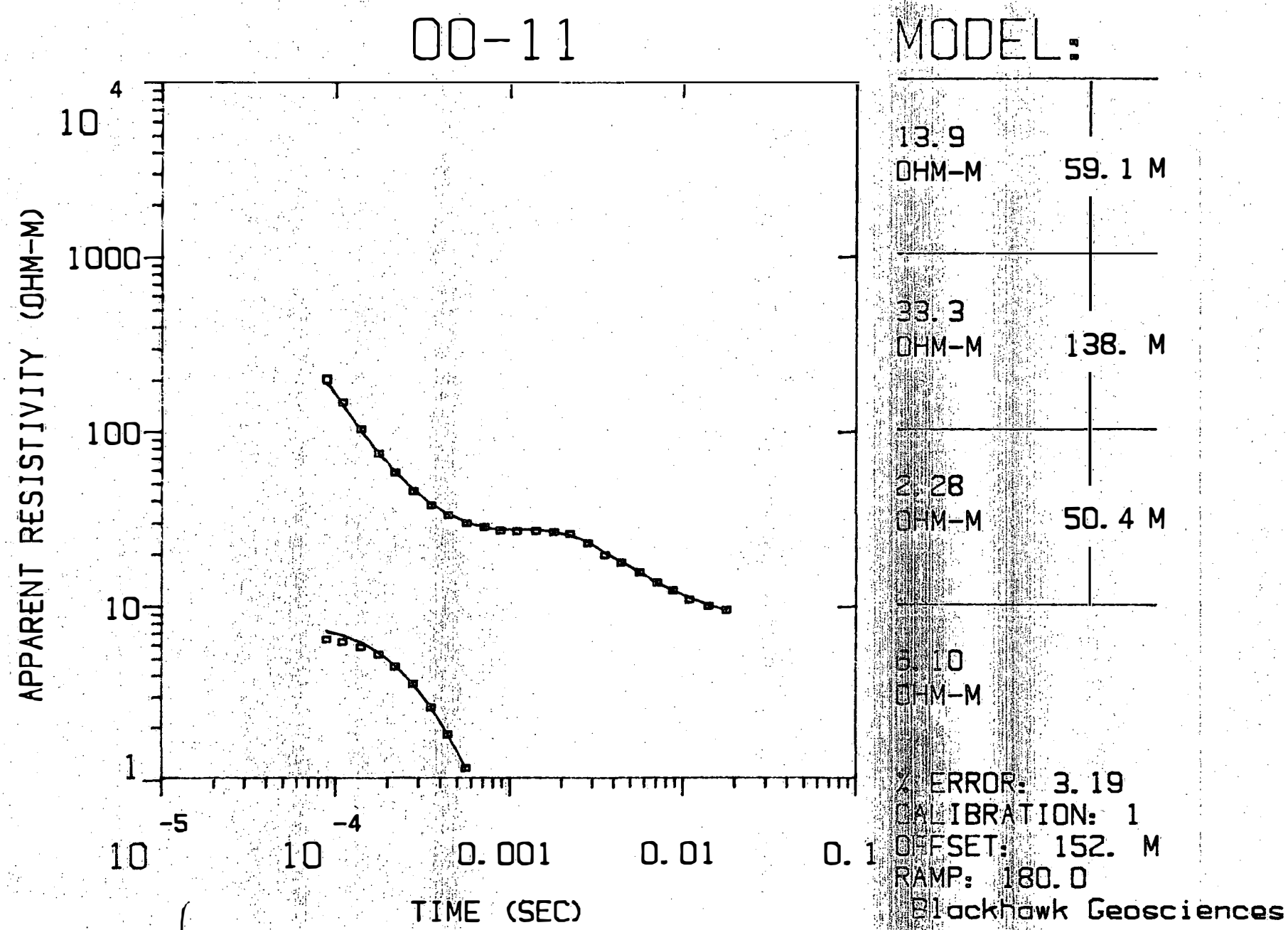
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 30 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-10

RMS LOG ERROR: 1.41E-02, ANTILOG YIELDS 3.3102 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
R 1 0.83

P 2	0.01	0.67							
P 3	0.00	-0.00	0.01						
P 4	0.01	0.07	-0.01	0.66					
P 5	-0.01	-0.06	0.02	-0.05	0.67				
T 1	0.00	0.18	0.01	-0.03	0.03	0.87			
T 2	0.01	-0.35	-0.06	0.08	-0.07	0.19	0.63		
T 3	0.00	-0.05	0.04	0.12	-0.01	0.03	-0.06	0.95	
T 4	0.00	0.04	-0.02	-0.40	-0.18	-0.02	0.05	0.12	0.47
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4


00-11
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
13.9
OHM-M
59.1 M
33.3
OHM-M
138. M
2.28
OHM-M
50.4 M
6.10
OHM-M
% ERROR: 3.19
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
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MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		195.1	640.0		
13.89	59.1	135.9	446.0	4.3	4.3
2.28	50.4	85.5	172.3	2.4	6.6
6.10					

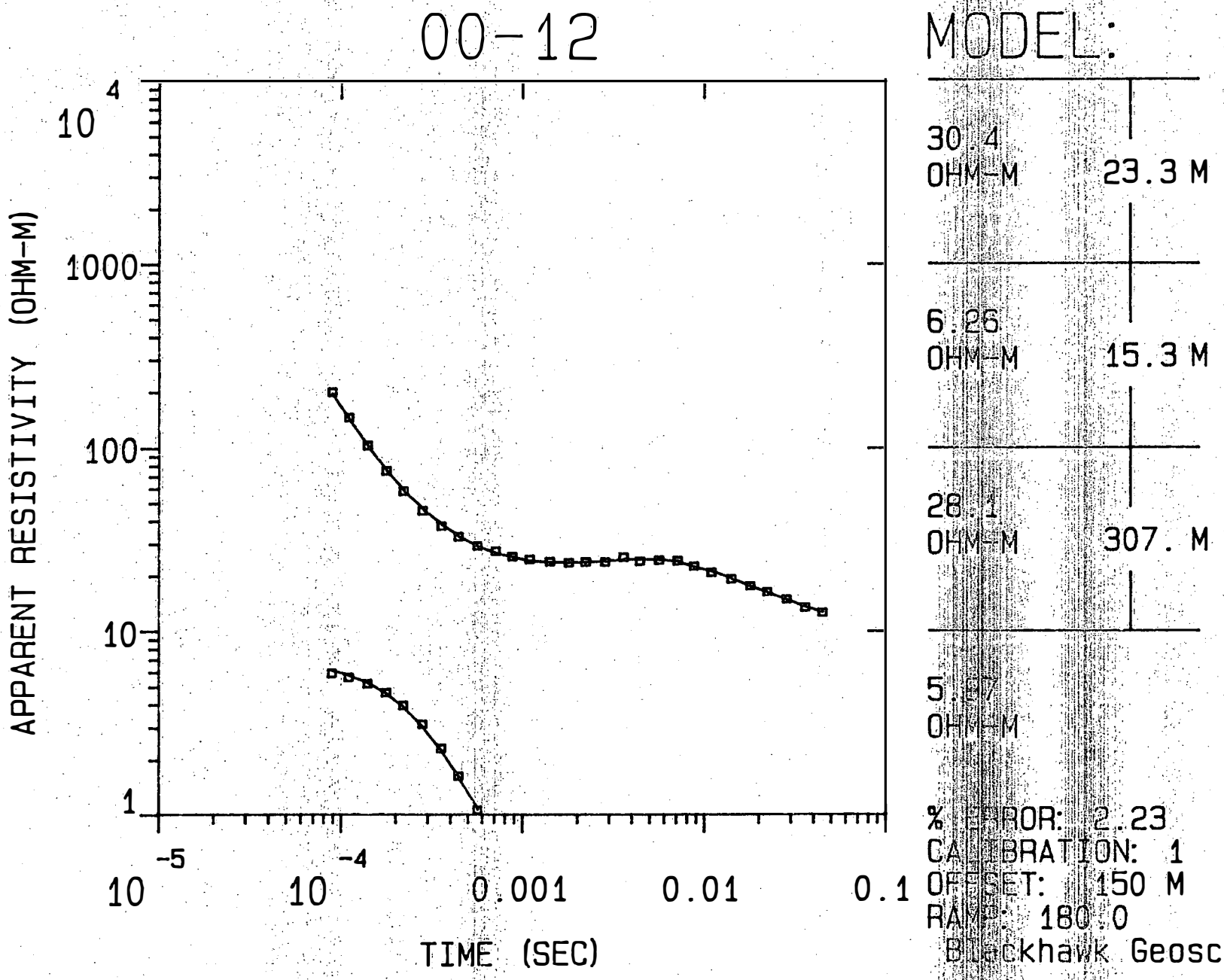
	LAM			
1	8.90E-05	2.02E+02	1.90E+02	
2	1.10E-04	1.46E+02	1.39E+02	5.239
3	1.40E-04	1.02E+02	9.87E+01	3.405
4	1.77E-04	7.38E+01	7.30E+01	1.047
5	2.20E-04	5.71E+01	5.70E+01	0.149
6	2.80E-04	4.46E+01	4.50E+01	-0.965
7	3.55E-04	3.70E+01	3.73E+01	-0.753
8	4.43E-04	3.25E+01	3.26E+01	-0.302
9	5.64E-04	2.93E+01	2.94E+01	-0.304
10	7.13E-04	2.79E+01	2.74E+01	1.582
11	8.81E-04	2.66E+01	2.67E+01	-0.089
12	1.10E-03	2.64E+01	2.66E+01	-0.560
13	1.41E-03	2.65E+01	2.64E+01	0.365
14	1.80E-03	2.62E+01	2.58E+01	1.616
15	2.22E-03	2.55E+01	2.49E+01	2.801
16	2.83E-03	2.26E+01	2.28E+01	-0.737
17	3.55E-03	1.94E+01	1.97E+01	-1.739
18	4.43E-03	1.75E+01	1.76E+01	-0.689
19	5.64E-03	1.54E+01	1.53E+01	0.890
20	7.13E-03	1.35E+01	1.33E+01	1.681
21	8.81E-03	1.22E+01	1.21E+01	1.413
22	1.10E-02	1.08E+01	1.10E+01	-2.154
23	1.41E-02	9.92E+00	9.97E+00	-0.452
24	1.80E-02	9.42E+00	9.31E+00	1.119

R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 24 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-11

RMS LOG ERROR: 1.36E-02, ANTILOG YIELDS 3.1855 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 1.00
P 2 0.00 1.00
P 3 0.00 0.00 1.00
P 4 0.00 0.00 -0.01 0.99
F 1 0.00 0.00 0.00 0.00 0.00
F 2 0.00 0.00 0.00 0.00 0.00 0.00


00-12
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
MODEL:
30.4
OHM-M
23.3 M
6.26
OHM-M
15.3 M
28.1
OHM-M
307. M
5.87
OHM-M
% ERROR: 2.23
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		237.1	778.0		
30.37	23.3	213.8	701.5	0.8	0.8
6.26	15.3	198.5	651.3	2.4	3.2
28.08	306.8	-108.3	-355.3	10.9	14.1
5.97					

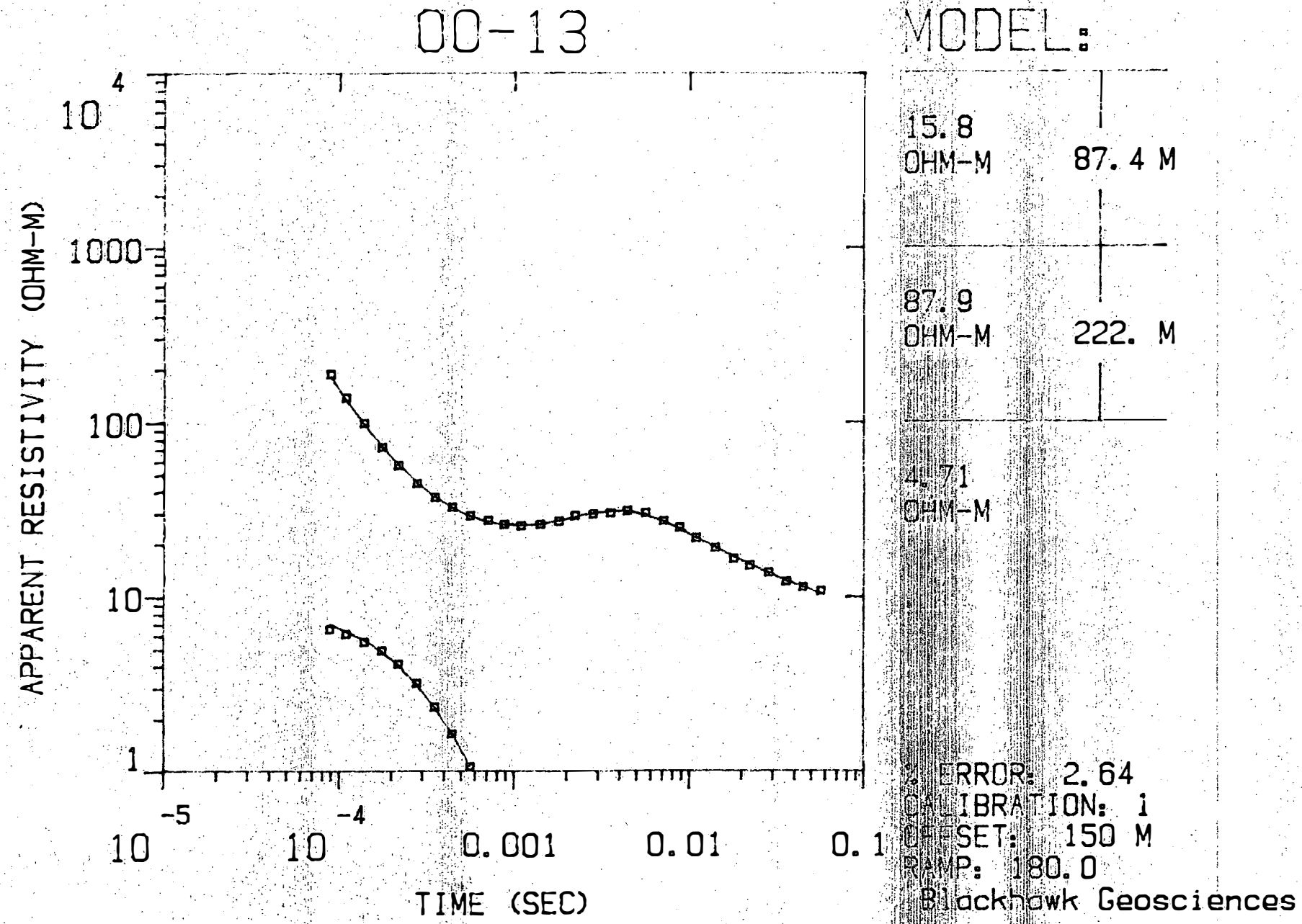
	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.40E+02	2.39E+02	0.584	
2	1.10E-04	1.46E+02	1.47E+02	-0.584	
3	1.40E-04	1.03E+02	1.03E+02	-0.584	
4	1.77E-04	7.52E+01	7.59E+01	-0.992	
5	2.20E-04	5.82E+01	5.91E+01	-1.439	
6	2.80E-04	4.55E+01	4.66E+01	-2.268	
7	3.55E-04	3.75E+01	3.84E+01	-2.338	
8	4.43E-04	3.28E+01	3.30E+01	-0.788	
9	5.64E-04	2.92E+01	2.90E+01	0.727	
10	7.13E-04	2.73E+01	2.67E+01	2.341	
11	8.81E-04	2.55E+01	2.53E+01	0.792	
12	1.10E-03	2.46E+01	2.41E+01	2.389	
13	1.41E-03	2.39E+01	2.37E+01	0.970	
14	1.80E-03	2.36E+01	2.37E+01	-0.356	
15	2.22E-03	2.39E+01	2.37E+01	0.629	
16	2.85E-03	2.39E+01	2.42E+01	-1.557	
17	3.60E-03	2.54E+01	2.48E+01	2.552	
18	4.43E-03	2.41E+01	2.48E+01	-2.655	
19	5.64E-03	2.44E+01	2.46E+01	-0.469	
20	7.13E-03	2.43E+01	2.40E+01	1.152	
21	8.81E-03	2.27E+01	2.24E+01	1.542	
22	1.10E-02	2.09E+01	2.12E+01	-1.370	
23	1.41E-02	1.92E+01	1.93E+01	-0.649	
24	1.80E-02	1.76E+01	1.75E+01	0.496	
25	2.22E-02	1.63E+01	1.62E+01	0.654	
26	2.85E-02	1.49E+01	1.48E+01	0.884	
27	3.60E-02	1.35E+01	1.36E+01	-0.883	
28	4.49E-02	1.26E+01	1.27E+01	-0.272	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 28 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-12

RMS LOG ERROR: 9.59E-03, ANTILOG YIELDS 2.2316 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.91
P 2 0.02 0.67
P 3 0.00 -0.02 0.99
P 4 0.00 0.00 -0.01 0.96


00-13
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
15.8
OHM-M
87.4 M
87.9
OHM-M
222. M
4.71
OHM-M
% ERROR: 2.64
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		277.1	909.0		
15.80	87.4	189.6	622.2	5.5	5.5
87.94	222.0	-32.3	-106.0	2.5	8.1
4.71					

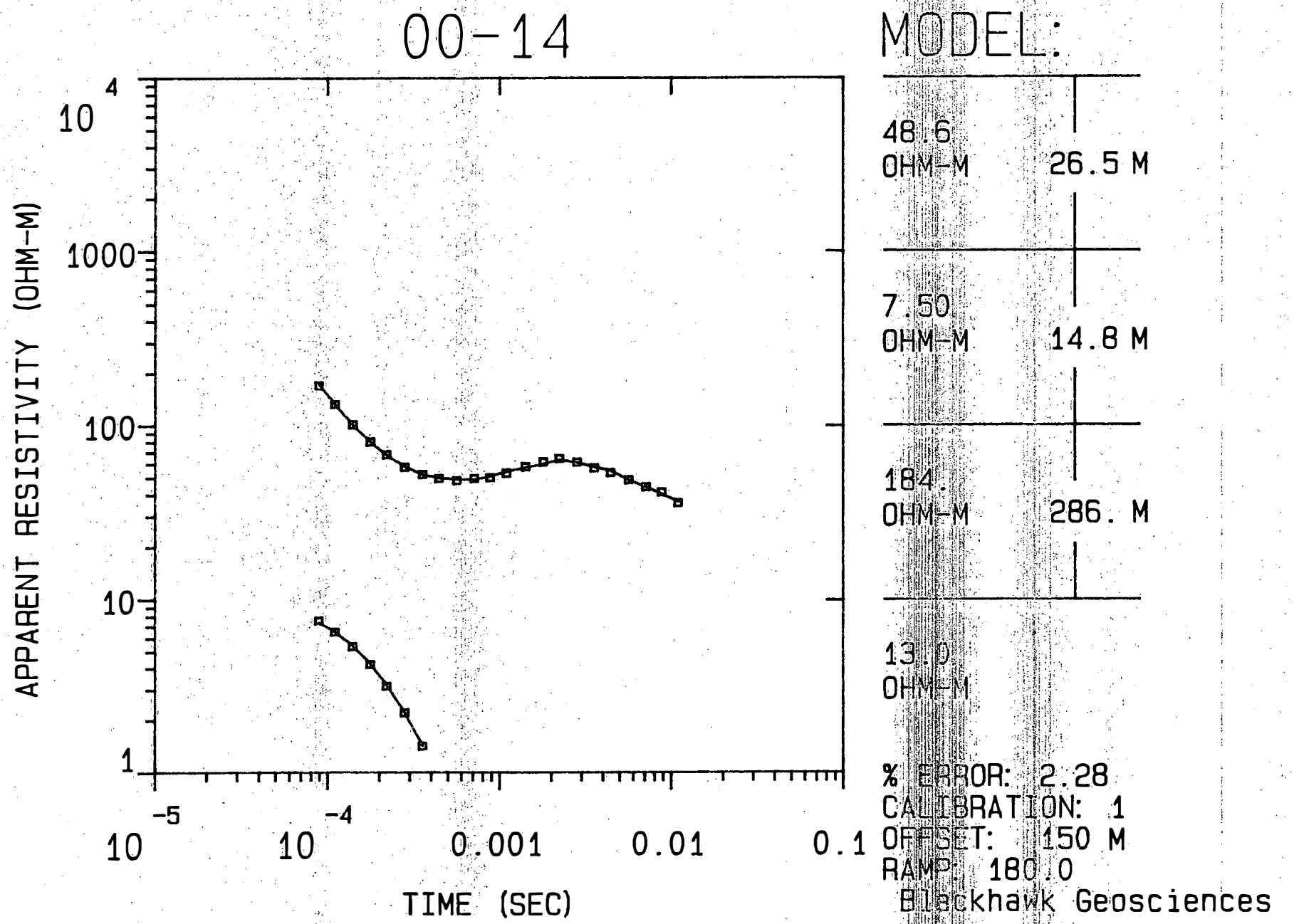
	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.88E+02	1.82E+02	3.561	
2	1.10E-04	1.58E+02	1.55E+02		
3	1.41E-04	1.31E+02	1.27E+02		
4	1.77E-04	7.22E+01	7.29E+01	-0.954	
5	2.20E-04	5.66E+01	5.73E+01	-1.079	
6	2.80E-04	4.47E+01	4.53E+01	-1.261	
7	3.55E-04	3.71E+01	3.74E+01	-0.797	
8	4.43E-04	3.26E+01	3.24E+01	0.525	
9	5.64E-04	2.91E+01	2.89E+01	0.989	
10	7.13E-04	2.74E+01	2.68E+01	2.269	
11	8.81E-04	2.60E+01	2.58E+01	0.449	
12	1.10E-03	2.55E+01	2.56E+01	-0.370	
13	1.41E-03	2.60E+01	2.61E+01	-0.641	
14	1.80E-03	2.72E+01	2.73E+01	-0.480	
15	2.22E-03	2.93E+01	2.87E+01	2.000	
16	2.83E-03	2.98E+01	3.02E+01	-1.416	
17	3.55E-03	3.03E+01	3.11E+01	-2.703	
18	4.43E-03	3.11E+01	3.09E+01	0.714	
19	5.64E-03	3.02E+01	2.94E+01	2.821	
20	7.13E-03	2.71E+01	2.69E+01	0.844	
21	8.81E-03	2.49E+01	2.44E+01	1.968	
22	1.10E-02	2.17E+01	2.18E+01	-0.692	
23	1.41E-02	1.90E+01	1.91E+01	-0.586	
24	1.80E-02	1.64E+01	1.69E+01	-3.094	
25	2.22E-02	1.50E+01	1.53E+01	-1.389	
26	2.85E-02	1.37E+01	1.36E+01	0.470	
27	3.60E-02	1.21E+01	1.23E+01	-1.616	
28	4.49E-02	1.13E+01	1.13E+01	-0.080	
29	5.70E-02	1.07E+01	1.03E+01	3.486	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-13

RMS LOG ERROR: 1.13E-02, ANTILOG YIELDS 2.6405 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 1.00
P 2 -0.01 0.21
P 3 0.00 -0.03 0.97


00-14
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
48.6
OHM-M
26.5 M
7.50
OHM-M
14.8 M
184.
OHM-M
286. M
13.0
OHM-M
% ERROR: 2.28
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		320.0	1050.0		
48.60	26.5	293.5	963.0	0.5	0.5
7.50	14.8	278.7	914.3	2.0	2.5
183.54	285.7	-7.0	-22.9	1.6	4.1
12.95					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.73E+02	1.72E+02	0.744	
2	1.10E-04	1.38E+02	1.38E+02	0.119	
3	1.40E-04	1.01E+02	1.00E+02	0.656	
4	1.77E-04	8.04E+01	7.99E+01	0.600	
5	2.20E-04	6.78E+01	6.72E+01	0.934	
6	2.80E-04	5.75E+01	5.77E+01	-0.204	
7	3.55E-04	5.22E+01	5.20E+01	0.252	
8	4.43E-04	4.94E+01	4.97E+01	-0.605	
9	5.64E-04	4.81E+01	4.87E+01	-1.218	
10	7.13E-04	4.94E+01	4.85E+01	1.720	
11	8.81E-04	5.00E+01	5.12E+01	-2.321	
12	1.10E-03	5.32E+01	5.43E+01	-2.093	
13	1.41E-03	5.78E+01	5.74E+01	0.803	
14	1.80E-03	6.15E+01	6.00E+01	2.480	
15	2.22E-03	6.44E+01	6.34E+01	1.504	
16	2.83E-03	6.13E+01	6.08E+01	0.735	
17	3.55E-03	5.67E+01	5.74E+01	-1.211	
18	4.43E-03	5.34E+01	5.49E+01	-2.803	
19	5.64E-03	4.84E+01	4.82E+01	0.496	
20	7.13E-03	4.41E+01	4.40E+01	0.219	
21	8.81E-03	4.13E+01	4.01E+01	2.888	
22	1.10E-02	3.59E+01	3.65E+01	-1.584	

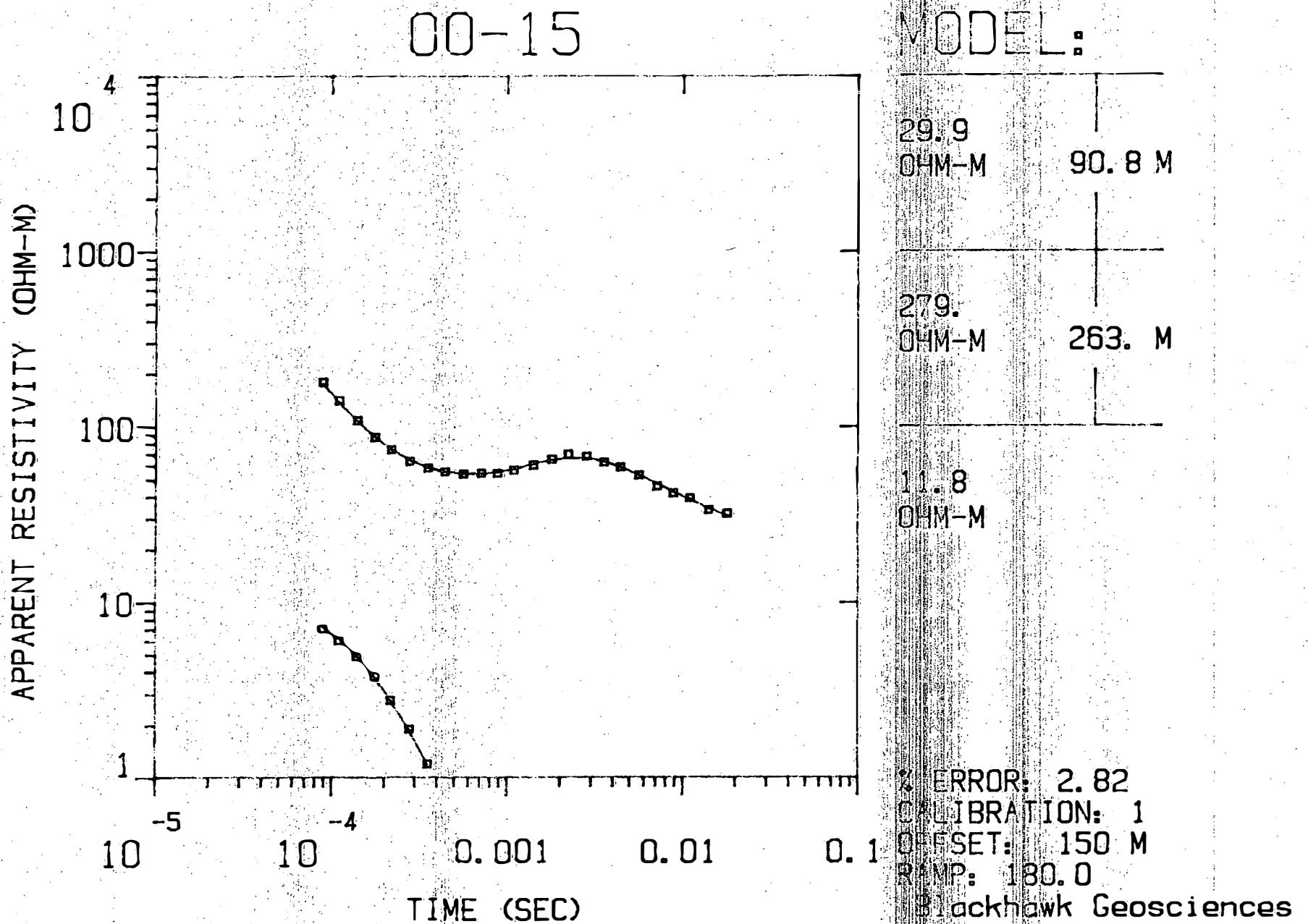
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 22 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-14

RMS LOG ERROR: 9.81E-03, ANTILOG YIELDS 2.2841 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.37						
P 2	0.12	0.53					
P 3	0.01	0.06	0.06				
P 4	-0.01	0.01	-0.03	0.20			
T 1	0.08	0.07	-0.07	0.04	0.35		
T 2	-0.07	-0.44	-0.11	0.03	0.10	0.44	
T 3	0.00	0.00	0.10	0.18	0.02	-0.01	0.86
	P 1	P 2	P 3	P 4	T 1	T 2	T 3


00-15
MODEL:
29.9
OHM-M
90.8 M
279.
OHM-M
263. M
11.8
OHM-M
% ERROR: 2.82
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		339.9	1115.0		
29.93	90.8	249.0	817.0	3.0	3.0
278.98	262.9	-13.8	-45.4	0.9	4.0
11.76					

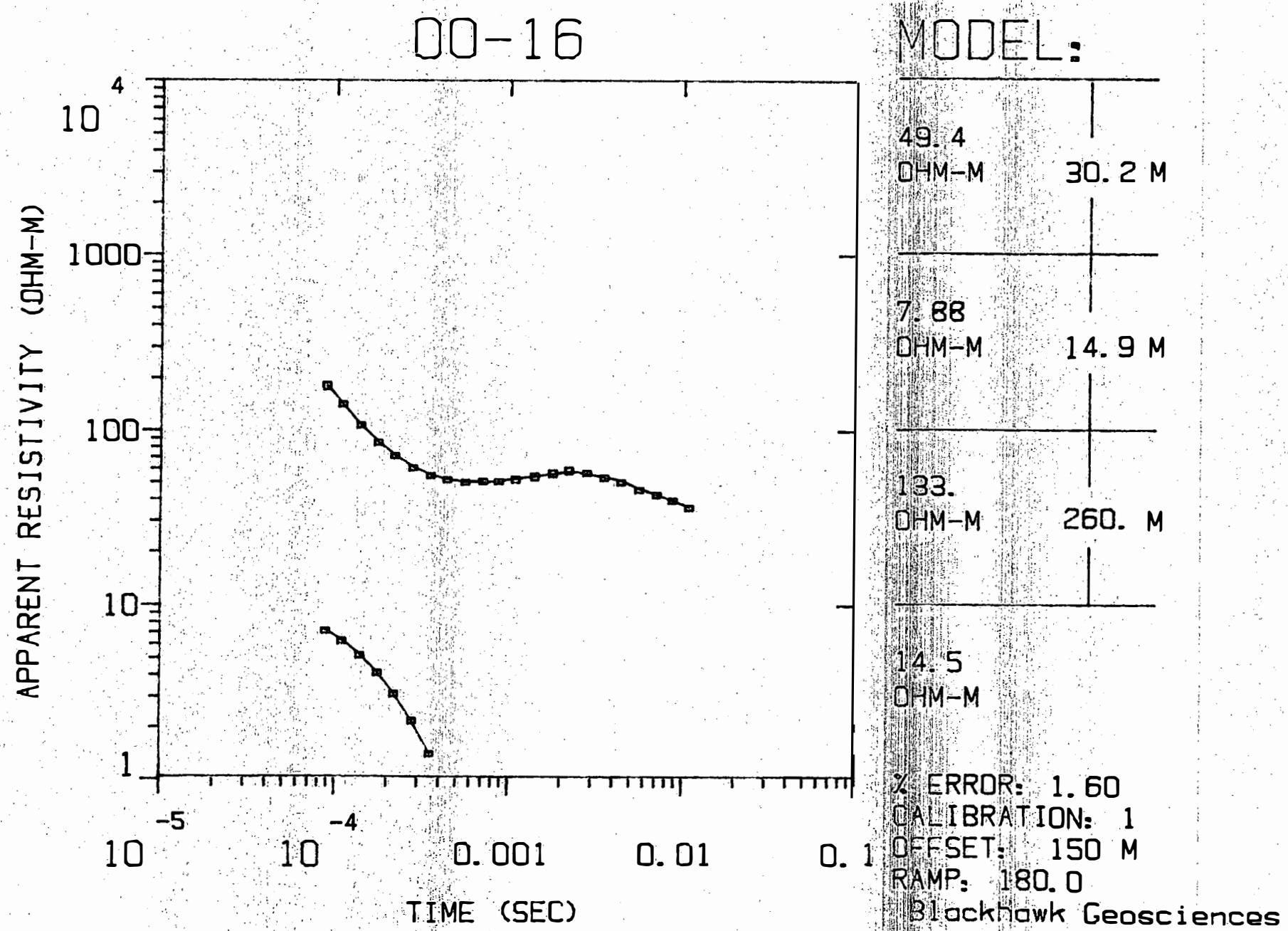
	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.80E+02	1.76E+02	2.408	
2	1.10E-04	1.43E+02	1.47E+02	-2.941	
3	1.40E-04	1.05E+02	1.02E+02	2.857	
4	1.77E-04	8.69E+01	8.71E+01	-0.298	
5	2.20E-04	7.42E+01	7.43E+01	-0.145	
6	2.80E-04	6.36E+01	6.46E+01	-1.541	
7	3.55E-04	5.83E+01	5.85E+01	-0.436	
8	4.43E-04	5.54E+01	5.52E+01	0.445	
9	5.64E-04	5.37E+01	5.36E+01	0.210	
10	7.13E-04	5.44E+01	5.38E+01	1.123	
11	8.81E-04	5.42E+01	5.52E+01	-1.700	
12	1.10E-03	5.66E+01	5.77E+01	-1.913	
13	1.41E-03	6.07E+01	6.15E+01	-1.190	
14	1.80E-03	6.54E+01	6.49E+01	0.772	
15	2.22E-03	6.99E+01	6.68E+01	4.610	
16	2.83E-03	6.78E+01	6.65E+01	2.076	
17	3.55E-03	6.27E+01	6.35E+01	-1.120	
18	4.43E-03	5.88E+01	5.88E+01	0.071	
19	5.64E-03	5.29E+01	5.29E+01	0.117	
20	7.13E-03	4.58E+01	4.72E+01	-3.111	
21	8.81E-03	4.18E+01	4.26E+01	-1.975	
22	1.10E-02	3.92E+01	3.84E+01	1.908	
23	1.41E-02	3.36E+01	3.43E+01	-2.046	
24	1.80E-02	3.21E+01	3.10E+01	3.459	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 24 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-15

RMS LOG ERROR: 1.21E-02, ANTILOG YIELDS 2.8242 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.99
P 2 -0.01 0.12
P 3 0.00 -0.05 0.93
T 1 -0.01 -0.12 0.01 0.97
T 2 0.00 0.09 0.02 0.01 0.98
P 1 P 2 P 3 T 1 T 2


00-16
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
49.4
OHM-M
30.2 M
7.88
OHM-M
14.9 M
133.
OHM-M
260. M
14.5
OHM-M
% ERROR: 1.60
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		374.9	1230.0		
49.42	30.2	344.7	1131.0	0.6	0.6
7.88	14.9	329.8	1082.0	1.9	2.5
132.73	260.2	69.6	228.3	2.0	4.5
14.58					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.80E+02	1.80E+02	0.010	
2	1.10E-04	1.39E+02	1.39E+02	0.111	
3	1.40E-04	1.05E+02	1.04E+02	0.284	
4	1.77E-04	8.27E+01	8.30E+01	-0.431	
5	2.20E-04	6.94E+01	6.96E+01	-0.281	
6	2.80E-04	5.89E+01	5.95E+01	-0.976	
7	3.55E-04	5.34E+01	5.34E+01	-0.054	
8	4.43E-04	5.04E+01	5.05E+01	-0.236	
9	5.64E-04	4.89E+01	4.88E+01	0.145	
10	7.13E-04	4.96E+01	4.82E+01	3.039	
11	8.81E-04	4.93E+01	5.01E+01	-1.602	
12	1.10E-03	5.12E+01	5.21E+01	-1.638	
13	1.41E-03	5.37E+01	5.39E+01	-0.423	
14	1.80E-03	5.61E+01	5.57E+01	0.640	
15	2.22E-03	5.82E+01	5.75E+01	1.277	
16	2.83E-03	5.56E+01	5.48E+01	1.387	
17	3.55E-03	5.20E+01	5.22E+01	-0.431	
18	4.43E-03	4.90E+01	4.97E+01	-1.402	
19	5.64E-03	4.40E+01	4.45E+01	-1.087	
20	7.13E-03	4.14E+01	4.12E+01	0.431	
21	8.81E-03	3.83E+01	3.80E+01	0.940	
22	1.10E-02	3.49E+01	3.50E+01	-0.122	

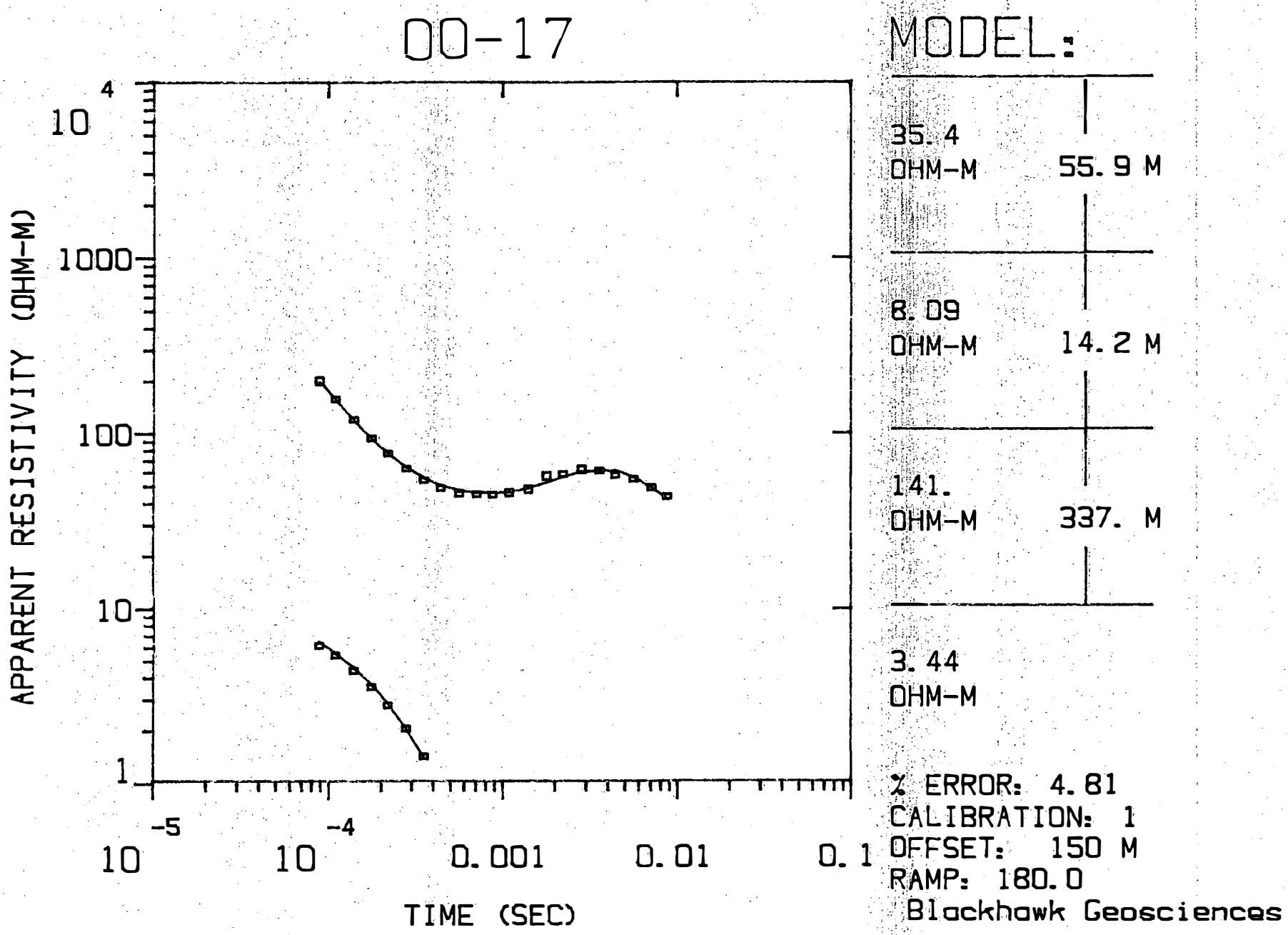
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 22 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-16

RMS LOG ERROR: 6.89E-03, ANTILOG YIELDS = 1.5987 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.34						
P 2	0.14	0.52					
P 3	0.01	0.09	0.12				
P 4	-0.01	0.01	-0.03	0.27			
T 1	0.12	0.08	-0.09	0.04	0.43		
T 2	-0.08	-0.43	-0.14	0.03	0.09	0.42	
T 3	0.00	-0.01	0.14	0.21	0.02	0.00	0.83
	P 1	P 2	P 3	P 4	T 1	T 2	T 3


00-17
MODEL:
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
35.4
OHM-M
55.9 M
8.09
OHM-M
14.2 M
141.
OHM-M
337. M
3.44
OHM-M
% ERROR: 4.81
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		390.1	1280.0		
35.42	55.9	334.3	1096.6	1.6	1.6
8.09	14.2	320.0	1050.0	1.8	3.3
141.26	337.3	-17.2	-56.5	2.4	5.7
3.44					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.99E+02	1.95E+02	2.099	
2	1.10E-04	1.53E+02	1.51E+02	1.205	
3	1.40E-04	1.17E+02	1.14E+02	2.154	
4	1.77E-04	9.13E+01	8.98E+01	1.667	
5	2.20E-04	7.44E+01	7.37E+01	0.939	
6	2.80E-04	6.09E+01	6.14E+01	-0.809	
7	3.55E-04	5.24E+01	5.34E+01	-1.824	
8	4.43E-04	4.72E+01	4.85E+01	-2.678	
9	5.64E-04	4.37E+01	4.53E+01	-3.422	
10	7.13E-04	4.35E+01	4.39E+01	-1.054	
11	8.81E-04	4.33E+01	4.40E+01	-1.606	
12	1.10E-03	4.50E+01	4.52E+01	-0.464	
13	1.41E-03	4.73E+01	4.80E+01	-1.463	
14	1.80E-03	5.66E+01	5.19E+01	9.148	
15	2.22E-03	5.74E+01	5.59E+01	2.567	
16	2.85E-03	6.17E+01	6.01E+01	2.717	
17	3.60E-03	5.97E+01	6.15E+01	-2.908	
18	4.43E-03	5.61E+01	5.96E+01	-5.903	
19	5.64E-03	5.30E+01	5.39E+01	-1.687	
20	7.13E-03	4.74E+01	4.67E+01	1.489	
21	8.81E-03	4.21E+01	4.02E+01	4.711	

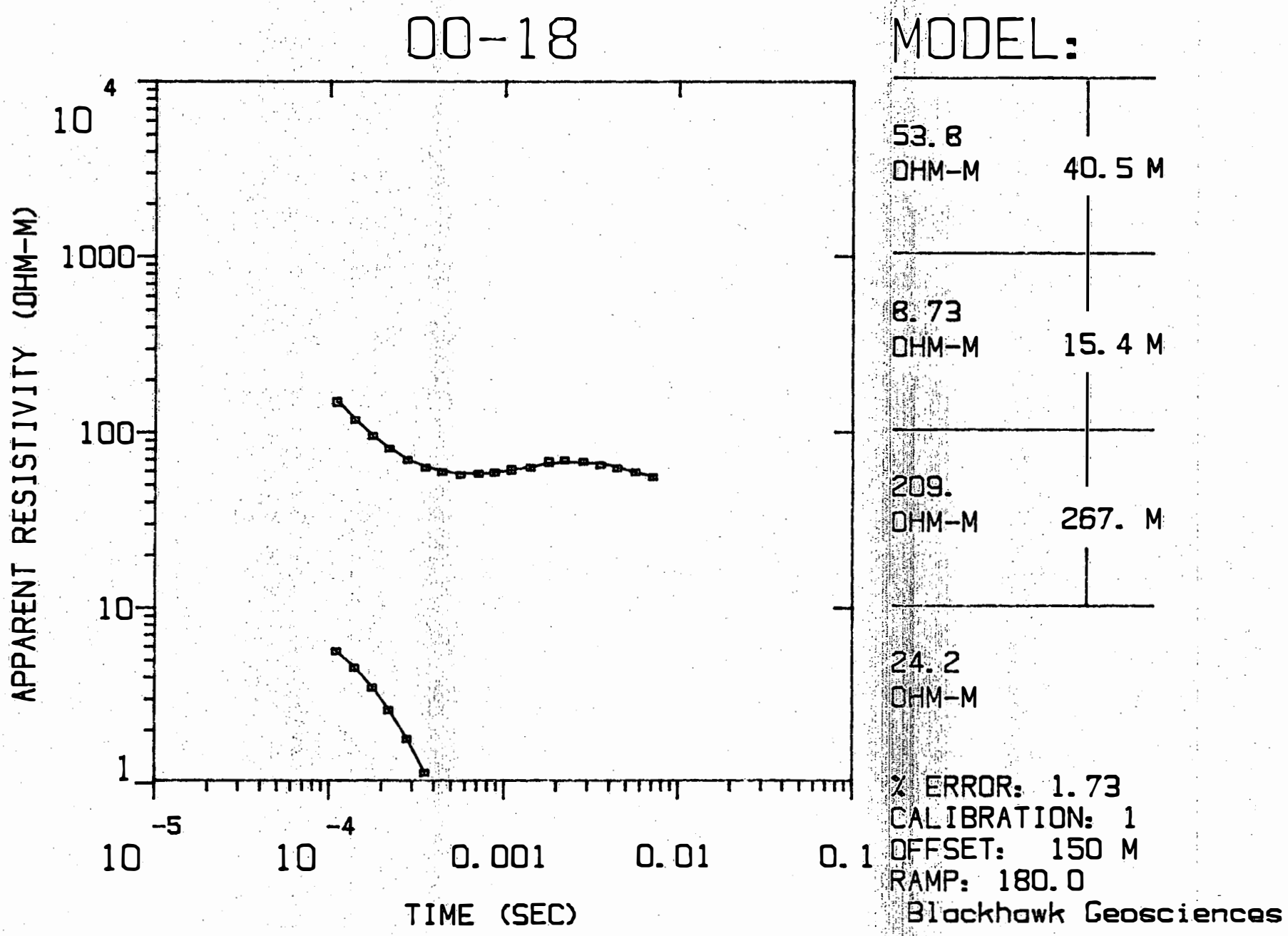
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 21 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-17

RMS LOG ERROR: 2.04E-02, ANTILOG YIELDS 4.8078 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.68						
P 2	0.22	0.36					
P 3	0.05	0.08	0.10				
P 4	-0.01	0.00	-0.05	0.04			
T 1	0.19	-0.13	-0.14	0.04	0.45		
T 2	-0.16	-0.33	-0.11	0.02	0.20	0.32	
T 3	-0.02	0.02	0.07	-0.02	0.07	-0.01	0.92
	P 1	P 2	P 3	P 4	T 1	T 2	T 3


00-18
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
MODEL:
53.8
OHM-M
40.5 M
8.73
OHM-M
15.4 M
209.
OHM-M
267. M
24.2
OHM-M
% ERROR: 1.73
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		410.0	1345.0		
53.80	40.5	369.4	1212.0	0.8	0.8
8.73	15.4	354.0	1161.5	1.8	2.5
208.74	267.1	87.0	285.3	1.3	3.8
24.21					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	1.10E-04	1.49E+02	1.50E+02	-0.482	
2	1.40E-04	1.15E+02	1.15E+02	0.085	
3	1.77E-04	9.27E+01	9.26E+01	0.141	
4	2.20E-04	7.85E+01	7.82E+01	0.408	
5	2.80E-04	6.75E+01	6.74E+01	0.051	
6	3.55E-04	6.10E+01	6.12E+01	-0.281	
7	4.43E-04	5.75E+01	5.80E+01	-0.707	
8	5.64E-04	5.55E+01	5.57E+01	-0.345	
9	7.13E-04	5.66E+01	5.59E+01	1.253	
10	8.81E-04	5.74E+01	5.83E+01	-1.458	
11	1.10E-03	6.04E+01	5.99E+01	0.683	
12	1.41E-03	6.15E+01	6.25E+01	-1.673	
13	1.80E-03	6.72E+01	6.59E+01	1.880	
14	2.21E-03	6.77E+01	6.76E+01	0.182	
15	2.83E-03	6.62E+01	6.49E+01	2.046	
16	3.55E-03	6.32E+01	6.49E+01	-2.579	
17	4.43E-03	6.06E+01	6.12E+01	-0.880	
18	5.64E-03	5.75E+01	5.68E+01	1.270	
19	7.13E-03	5.39E+01	5.39E+01	0.032	

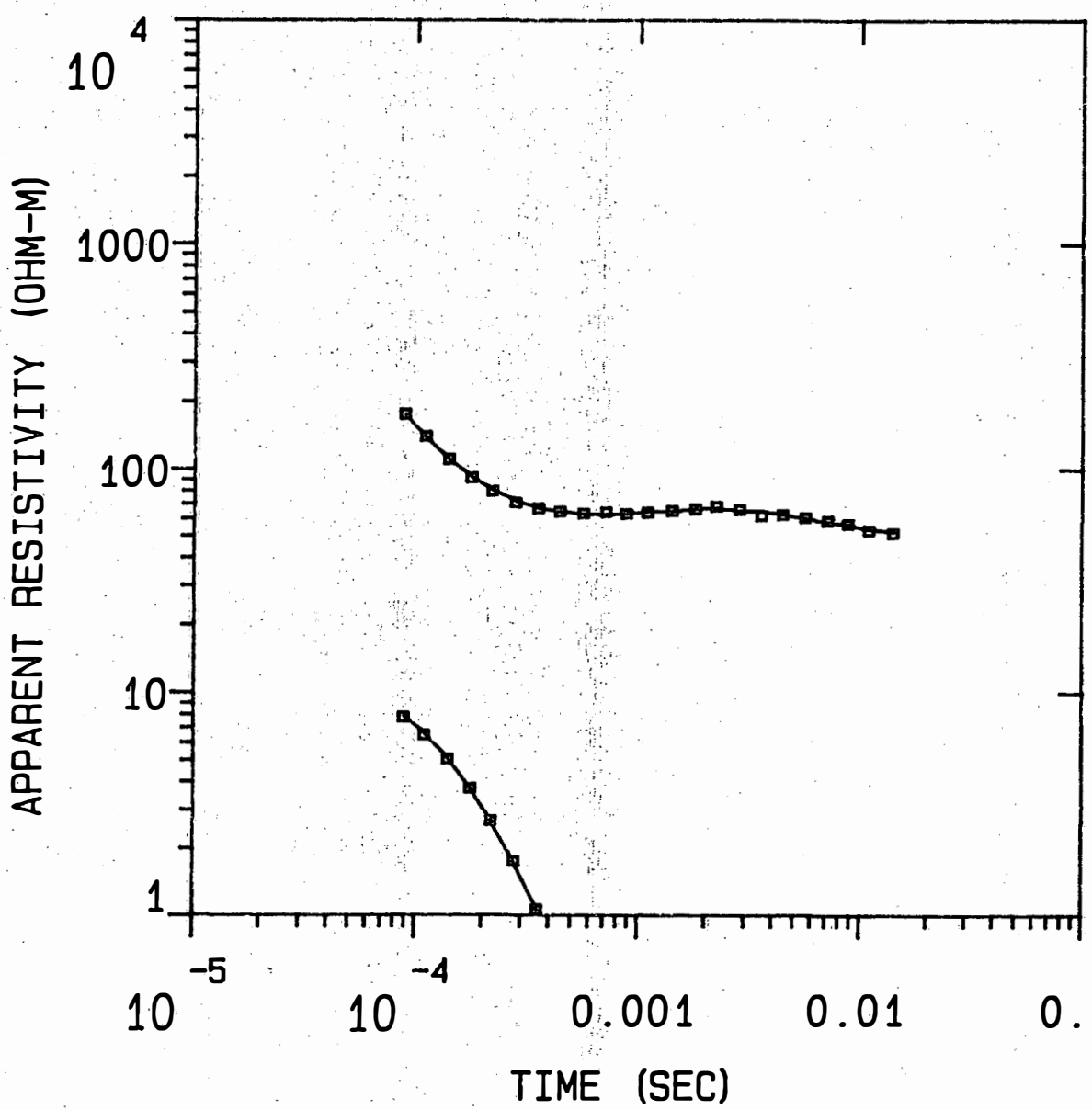
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 19 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-18

RMS LOG ERROR: 7.47E-03, ANTILOG YIELDS 1.7341 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.38						
P 2	0.18	0.49					
P 3	0.01	0.07	0.06				
P 4	0.00	0.00	0.00	0.18			
T 1	0.16	0.05	-0.08	0.04	0.51		
T 2	-0.12	-0.43	-0.10	0.03	0.11	0.42	
T 3	0.00	0.00	0.13	0.24	-0.01	-0.03	0.76
	P 1	P 2	P 3	P 4	T 1	T 2	T 3



MODEL:

32.5
OHM-M

30.3 M

11.4
OHM-M

9.02 M

103.
OHM-M

271. M

37.1
OHM-M

% ERROR: 2.31
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		380.4	1248.0		
32.49	30.3	350.1	1148.5	0.9	0.9
11.38	9.0	341.1	1118.9	0.8	1.7
102.89	270.6	70.4	231.1	2.6	4.4
37.09					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.76E+02	1.75E+02	0.655	
2	1.10E-04	1.40E+02	1.39E+02	1.062	
3	1.40E-04	1.11E+02	1.10E+02	0.412	
4	1.77E-04	9.16E+01	9.20E+01	-0.508	
5	2.20E-04	7.97E+01	8.05E+01	-0.951	
6	2.80E-04	7.07E+01	7.18E+01	-1.605	
7	3.55E-04	6.66E+01	6.67E+01	-0.270	
8	4.43E-04	6.44E+01	6.43E+01	0.206	
9	5.64E-04	6.34E+01	6.27E+01	1.067	
10	7.13E-04	6.42E+01	6.24E+01	2.902	
11	8.81E-04	6.30E+01	6.34E+01	-0.725	
12	1.10E-03	6.39E+01	6.50E+01	-1.695	
13	1.41E-03	6.51E+01	6.48E+01	0.405	
14	1.80E-03	6.64E+01	6.68E+01	-0.650	
15	2.22E-03	6.81E+01	6.71E+01	1.393	
16	2.83E-03	6.57E+01	6.46E+01	1.722	
17	3.55E-03	6.18E+01	6.48E+01	-4.549	
18	4.43E-03	6.26E+01	6.24E+01	0.223	
19	5.64E-03	6.07E+01	5.98E+01	1.505	
20	7.13E-03	5.88E+01	5.79E+01	1.565	
21	8.81E-03	5.68E+01	5.62E+01	1.114	
22	1.10E-02	5.31E+01	5.35E+01	-0.833	
23	1.41E-02	5.17E+01	5.23E+01	-1.168	

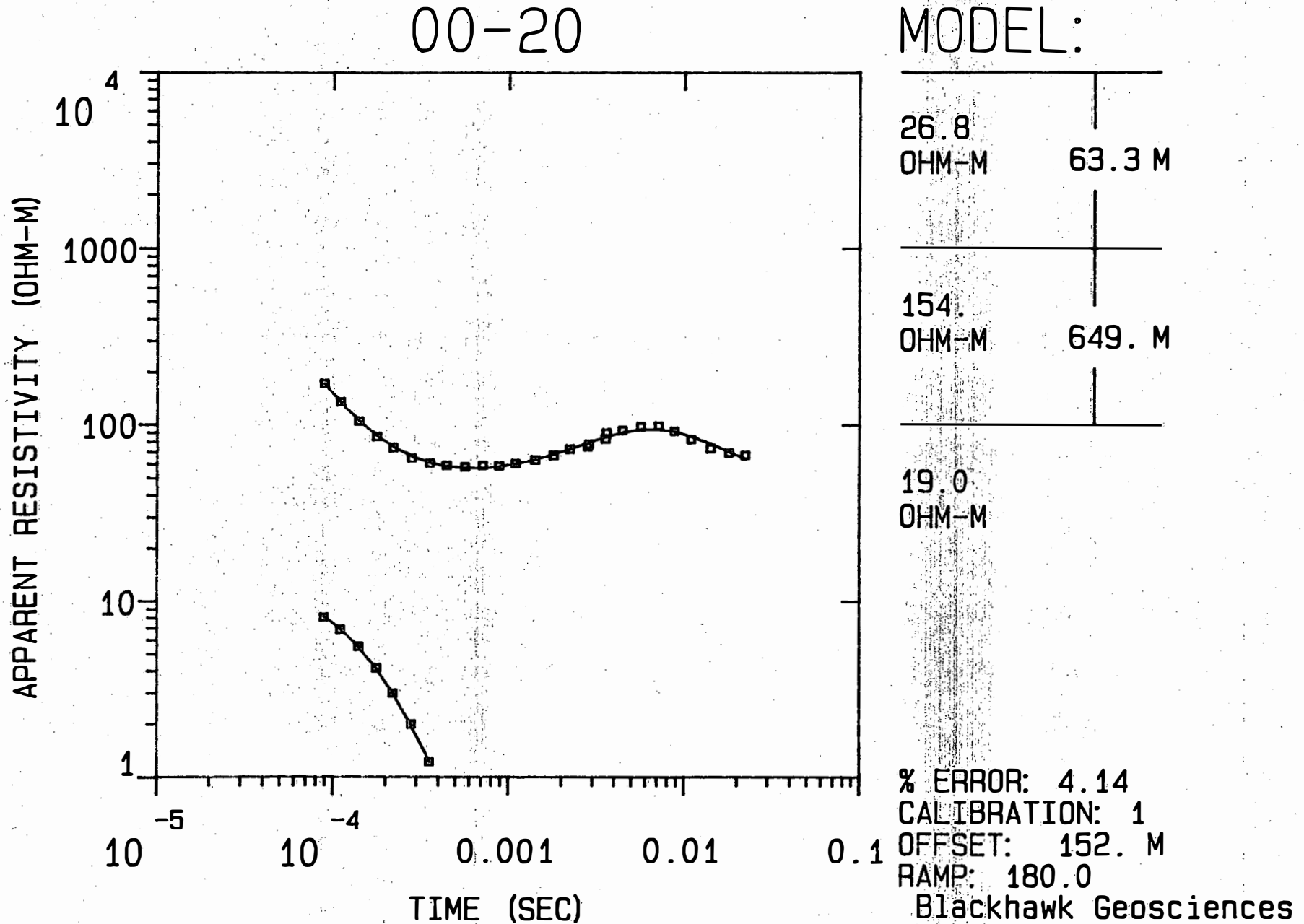
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 23 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-19

RMS LOG ERROR: 9.93E-03, ANTILOG YIELDS 2.3133 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.96						
P 2	0.05	0.58					
P 3	0.00	-0.02	0.91				
P 4	0.00	0.00	-0.03	0.96			
T 1	0.05	0.00	-0.12	-0.03	0.67		
T 2	-0.03	-0.42	-0.03	0.00	0.17	0.36	
T 3	0.00	0.02	0.08	0.05	0.10	0.02	0.91
	P 1	P 2	P 3	P 4	T 1	T 2	T 3



MODEL:

26.8
OHM-M

63.3 M

154.
OHM-M

649. M

19.0
OHM-M

% ERROR: 4.14
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		360.0	1181.0		
26.84	63.3	296.6	973.2	2.4	2.4
153.99	649.1	-352.5	-1156.4	4.2	6.6
18.99					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.72E+02	1.71E+02	0.478	
2	1.10E-04	1.35E+02	1.34E+02	0.596	
3	1.40E-04	1.05E+02	1.05E+02	-0.433	
4	1.77E-04	8.54E+01	8.64E+01	-1.148	
5	2.20E-04	7.41E+01	7.47E+01	-0.767	
6	2.80E-04	6.48E+01	6.61E+01	-1.841	
7	3.55E-04	6.07E+01	6.08E+01	-0.180	
8	4.43E-04	5.87E+01	5.80E+01	1.310	
9	5.64E-04	5.77E+01	5.67E+01	1.711	
10	7.13E-04	5.88E+01	5.69E+01	3.342	
11	8.81E-04	5.84E+01	5.81E+01	0.496	
12	1.10E-03	6.03E+01	6.03E+01	0.083	
13	1.41E-03	6.33E+01	6.39E+01	-0.887	
14	1.80E-03	6.72E+01	6.83E+01	-1.688	
15	2.22E-03	7.29E+01	7.31E+01	-0.352	
16	2.80E-03	7.49E+01	7.90E+01	-5.229	
17	2.85E-03	7.74E+01	7.95E+01	-2.635	
18	3.55E-03	8.34E+01	8.54E+01	-2.416	
19	3.60E-03	8.98E+01	8.58E+01	4.666	
20	4.43E-03	9.28E+01	9.07E+01	2.258	
21	5.64E-03	9.75E+01	9.42E+01	3.486	
22	7.13E-03	9.84E+01	9.42E+01	4.489	
23	8.81E-03	9.17E+01	9.10E+01	0.690	
24	1.10E-02	8.24E+01	8.55E+01	-3.613	
25	1.41E-02	7.35E+01	7.77E+01	-5.434	
26	1.80E-02	6.94E+01	7.01E+01	-0.999	
27	2.22E-02	6.72E+01	6.38E+01	5.332	

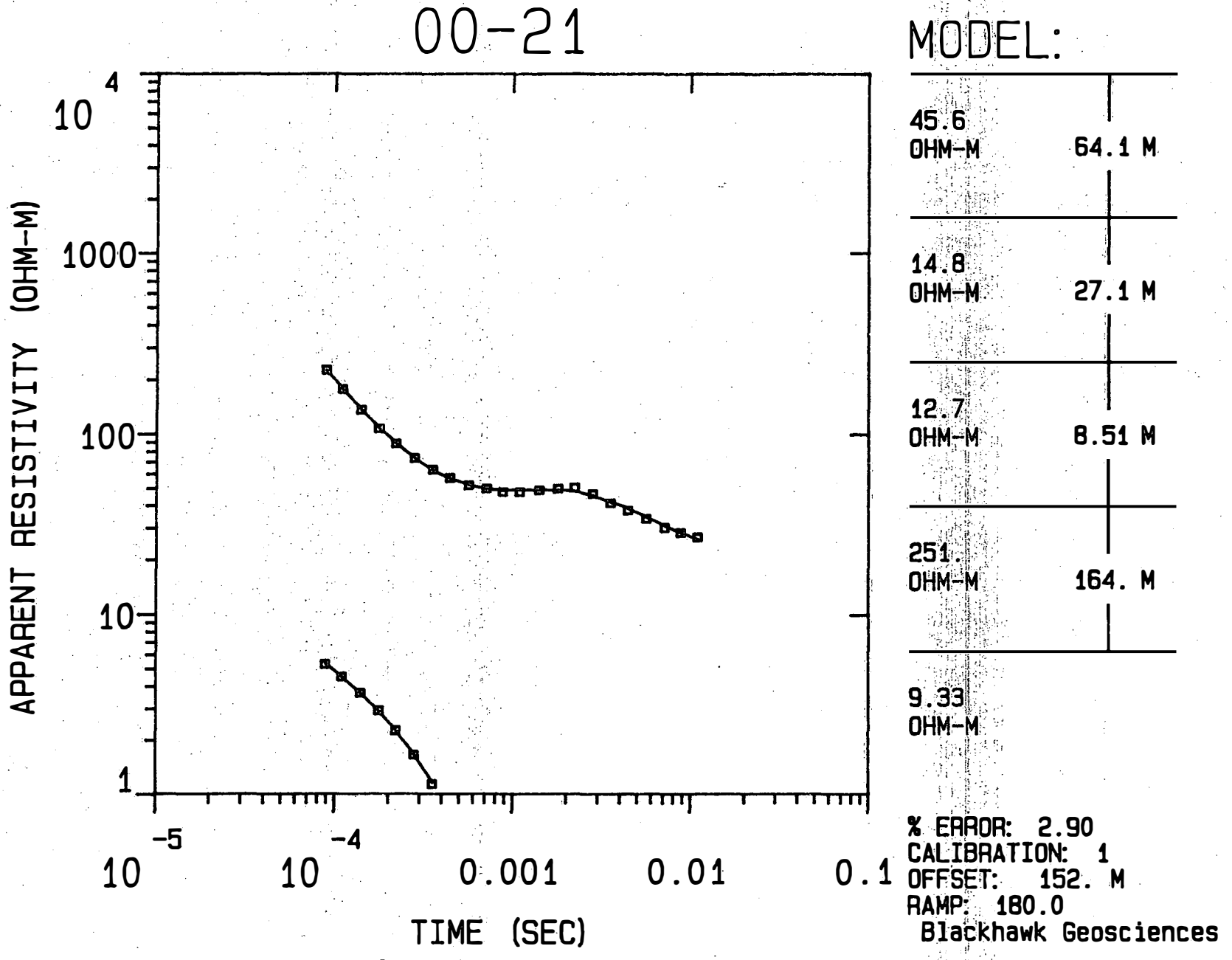
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 27 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-20

RMS LOG ERROR: 1.76E-02, ANTILOG YIELDS 4.1414 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

	P 1	P 2	P 3	T 1	T 2
P 1	1.00				
P 2	0.00	1.00			
P 3	0.00	0.00	0.99		
T 1	0.00	0.00	0.00	1.00	
T 2	0.00	0.00	0.00	0.00	1.00


00-21
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
MODEL:
45.6
OHM-M
64.1 M
14.8
OHM-M
27.1 M
12.7
OHM-M
8.51 M
251.
OHM-M
164. M
9.33
OHM-M
% ERROR: 2.90
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		349.9	1148.0		
45.60	64.1	285.8	937.8	1.4	1.4
14.83	27.1	258.8	848.9	1.8	3.2
12.72	8.5	250.2	821.0	0.7	3.9
251.23	164.4	85.8	281.5	0.7	4.6
9.33					

	TIMES	DATA	CALC	%ERROR	STD ERR
1	8.90E-05	2.28E+02	2.27E+02	0.506	
2	1.10E-04	1.78E+02	1.78E+02	-0.377	
3	1.40E-04	1.37E+02	1.37E+02	-0.378	
4	1.77E-04	1.08E+02	1.08E+02	-0.775	
5	2.20E-04	8.89E+01	8.89E+01	-0.008	
6	2.80E-04	7.35E+01	7.32E+01	0.418	
7	3.55E-04	6.35E+01	6.29E+01	1.047	
8	4.43E-04	5.71E+01	5.67E+01	0.733	
9	5.64E-04	5.21E+01	5.22E+01	-0.267	
10	7.13E-04	4.98E+01	4.94E+01	0.833	
11	8.81E-04	4.78E+01	4.88E+01	-2.148	
12	1.10E-03	4.77E+01	4.93E+01	-3.110	
13	1.41E-03	4.88E+01	4.88E+01	-0.042	
14	1.80E-03	4.98E+01	4.88E+01	1.902	
15	2.22E-03	5.05E+01	4.82E+01	4.807	
16	2.83E-03	4.66E+01	4.55E+01	2.442	
17	3.55E-03	4.14E+01	4.17E+01	-0.792	
18	4.43E-03	3.77E+01	3.87E+01	-2.545	
19	5.64E-03	3.38E+01	3.44E+01	-1.908	
20	7.13E-03	3.02E+01	3.09E+01	-2.385	
21	8.81E-03	2.83E+01	2.83E+01	0.135	
22	1.10E-02	2.67E+01	2.58E+01	3.732	

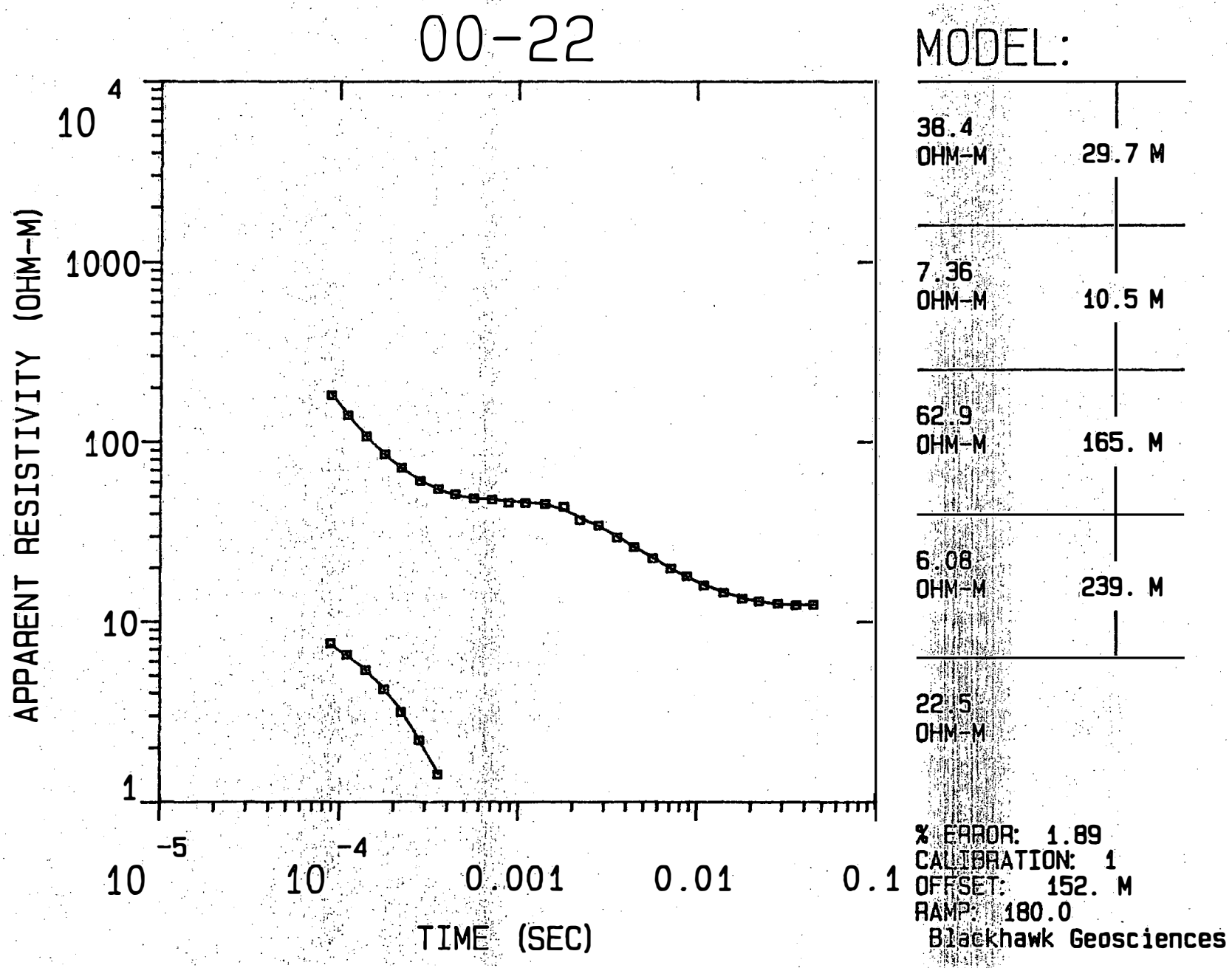
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 22 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-21

RMS LOG ERROR: 1.24E-02, ANTILOG YIELDS 2.9031 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.98								
P 2	-0.01	0.66							
P 3	0.00	0.17	0.05						
P 4	0.01	0.01	0.02	0.03					
P 5	-0.01	0.03	0.00	-0.03	0.95				
T 1	0.03	0.14	-0.04	-0.03	0.00	0.90			
T 2	-0.03	-0.35	-0.13	-0.07	0.04	0.18	0.38		
T 3	-0.01	-0.15	-0.05	-0.02	0.01	0.06	0.13	0.05	
T 4	0.00	0.00	0.04	0.07	0.02	0.00	0.01	0.00	0.99


00-22
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
MODEL:
38.4
OHM-M
29.7 M
7.36
OHM-M
10.5 M
62.9
OHM-M
165. M
6.08
OHM-M
239. M
22.5
OHM-M
% ERROR: 1.89
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		170.1	558.0		
38.37	29.7	140.4	460.5	0.8	0.8
7.36	10.5	129.9	426.2	1.4	2.2
62.86	164.9	-35.0	-114.9	2.6	4.8
6.08	238.9	-273.9	-898.6	39.3	44.1
22.50					

	TIMES	DATA	CALC	ERROR	STD ERR
1	8.90E-05	1.81E+02	1.84E+02	-1.663	
2	1.10E-04	1.40E+02	1.40E+02	-0.350	
3	1.40E-04	1.07E+02	1.07E+02	-0.044	
4	1.77E-04	8.50E+01	8.46E+01	0.437	
5	2.20E-04	7.18E+01	7.09E+01	1.274	
6	2.80E-04	6.08E+01	6.09E+01	-0.119	
7	3.55E-04	5.48E+01	5.45E+01	0.662	
8	4.43E-04	5.12E+01	5.05E+01	1.289	
9	5.64E-04	4.85E+01	4.86E+01	-0.115	
10	7.13E-04	4.78E+01	4.81E+01	-0.679	
11	8.81E-04	4.61E+01	4.71E+01	-2.186	
12	1.10E-03	4.59E+01	4.63E+01	-0.859	
13	1.41E-03	4.53E+01	4.50E+01	0.691	
14	1.80E-03	4.37E+01	4.20E+01	4.053	
15	2.20E-03	3.69E+01	3.80E+01	-2.935	
16	2.80E-03	3.45E+01	3.42E+01	0.805	
17	3.55E-03	2.96E+01	3.00E+01	-1.145	
18	4.43E-03	2.62E+01	2.61E+01	0.241	
19	5.64E-03	2.27E+01	2.27E+01	-0.350	
20	7.13E-03	2.00E+01	1.99E+01	0.277	
21	8.81E-03	1.80E+01	1.78E+01	1.206	
22	1.10E-02	1.60E+01	1.61E+01	-0.709	
23	1.41E-02	1.45E+01	1.46E+01	-0.494	
24	1.80E-02	1.35E+01	1.35E+01	-0.412	
25	2.22E-02	1.30E+01	1.30E+01	-0.127	
26	2.85E-02	1.26E+01	1.25E+01	0.935	
27	3.60E-02	1.23E+01	1.24E+01	-0.055	
28	4.49E-02	1.24E+01	1.24E+01	-0.154	

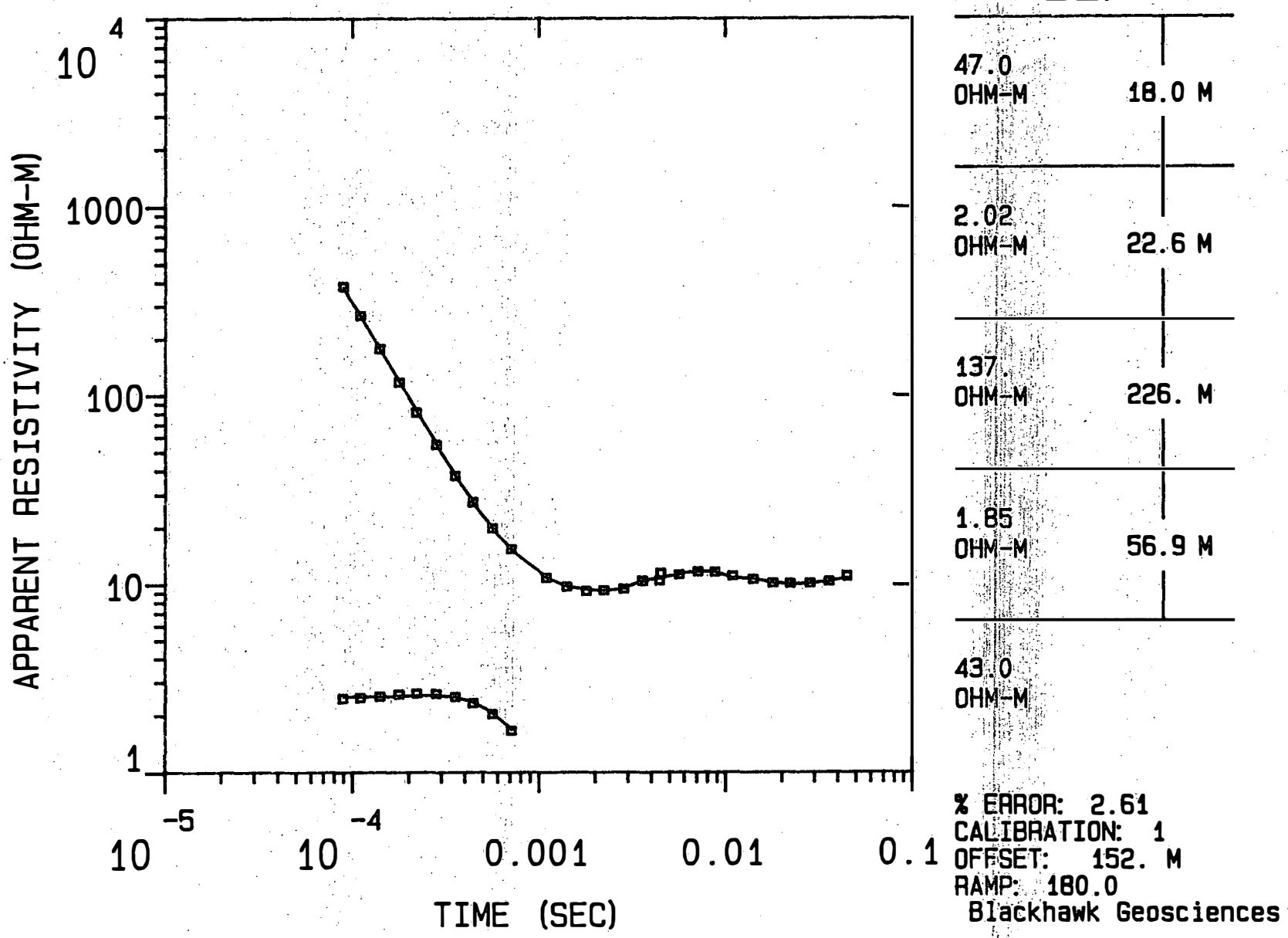
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
TDHZ ARRAY, 28 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-22

RMS LOG ERROR: 8.12E-03, ANTILOG YIELDS 1.8884 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.30

P 2	0.21	0.41							
P 3	0.04	0.19	0.22						
P 4	0.00	0.00	-0.03	0.77					
P 5	0.00	0.00	0.01	0.03	0.03				
T 1	0.15	0.05	-0.10	0.03	0.00	0.28			
T 2	-0.15	-0.34	-0.20	0.02	0.00	0.04	0.31		
T 3	-0.02	0.00	0.12	0.10	-0.02	0.10	0.03	0.88	
T 4	0.00	0.00	-0.04	-0.23	-0.08	0.02	0.01	0.09	0.32
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4



MODEL:

47.0 OHM-M	18.0 M
2.02 OHM-M	22.6 M
137. OHM-M	226. M
1.85 OHM-M	56.9 M
43.0 OHM-M	

% ERROR: 2.61
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		189.9	623.0		
46.98	18.0	171.9	564.0	0.4	0.4
2.02	22.6	149.3	489.9	11.2	11.6
137.26	226.3	-77.0	-252.7	1.6	13.2
1.85	56.9	-133.9	-439.4	30.8	44.1
42.96					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	3.81E+02	3.76E+02	1.304	
2	1.10E-04	2.67E+02	2.65E+02	0.687	
3	1.40E-04	1.77E+02	1.76E+02	0.089	
4	1.77E-04	1.17E+02	1.19E+02	-1.254	
5	2.20E-04	8.09E+01	8.22E+01	-1.581	
6	2.80E-04	5.44E+01	5.50E+01	-1.058	
7	3.55E-04	3.76E+01	3.77E+01	-0.374	
8	4.43E-04	2.73E+01	2.72E+01	0.622	
9	5.64E-04	1.99E+01	1.98E+01	0.667	
10	7.13E-04	1.54E+01	1.53E+01	0.753	
11	1.10E-03	1.09E+01	1.08E+01	0.362	
12	1.41E-03	9.72E+00	9.73E+00	-0.094	
13	1.80E-03	9.18E+00	9.39E+00	-2.221	
14	2.22E-03	9.29E+00	9.20E+00	1.051	
15	2.85E-03	9.48E+00	9.59E+00	-1.164	
16	3.60E-03	1.05E+01	1.05E+01	-0.418	
17	4.43E-03	1.05E+01	1.09E+01	-3.325	
18	4.49E-03	1.15E+01	1.09E+01	5.705	
19	5.64E-03	1.13E+01	1.14E+01	-1.153	
20	7.13E-03	1.17E+01	1.19E+01	-1.140	
21	8.81E-03	1.17E+01	1.17E+01	-0.217	
22	1.10E-02	1.11E+01	1.07E+01	3.489	
23	1.41E-02	1.07E+01	1.08E+01	-0.955	
24	1.80E-02	1.02E+01	1.02E+01	0.101	
25	2.22E-02	1.01E+01	1.00E+01	1.190	
26	2.85E-02	1.02E+01	1.02E+01	-0.013	
27	3.60E-02	1.04E+01	1.05E+01	-0.657	
28	4.49E-02	1.12E+01	1.09E+01	2.506	

R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 28 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-23
LOW FREQ

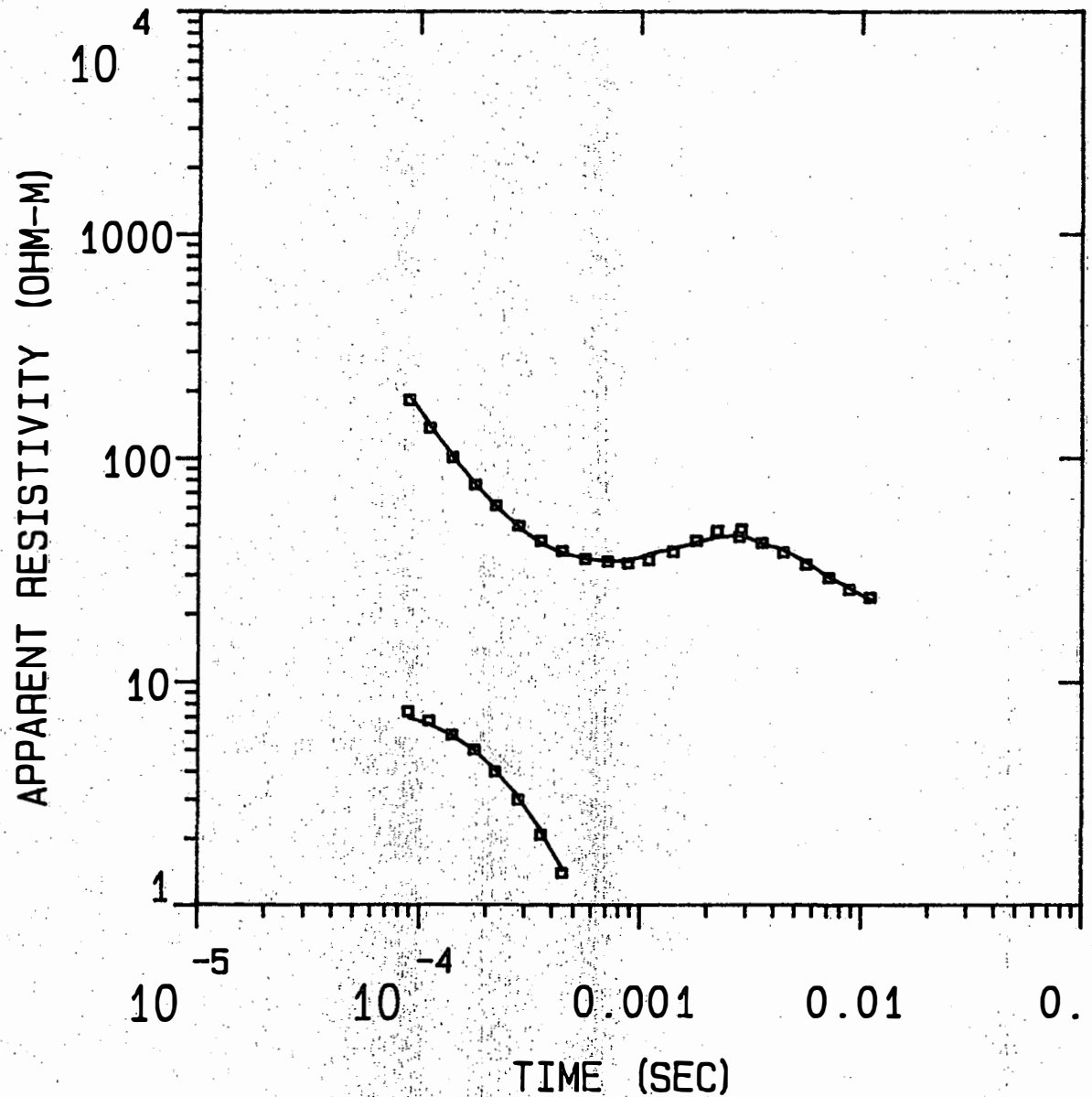
RMS LOG ERROR: 1.12E-02, ANTILOG YIELDS 2.6057 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 1.00
P 2 0.00 0.98
P 3 0.00 -0.03 0.15

P 4	0.00	0.02	-0.02	0.56					
P 5	0.00	-0.03	0.04	-0.08	0.79				
T 1	0.00	0.02	0.03	-0.02	0.02	0.98			
T 2	0.00	-0.03	-0.06	0.03	-0.03	0.02	0.97		
T 3	0.00	-0.01	0.02	0.06	0.00	0.01	-0.01	0.99	
T 4	0.00	0.01	-0.03	-0.46	-0.13	-0.01	0.02	0.06	0.50
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4

00-24



MODEL:

43.0 OHM-M — 25.0 M

6.23 OHM-M — 19.1 M

276. OHM-M — 240. M

5.40 OHM-M

% ERROR: 4.63
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		231.0	758.0		
42.95	25.0	206.0	675.8	0.6	0.6
6.23	19.1	186.8	613.0	3.1	3.7
276.21	239.9	-53.0	-174.0	0.9	4.5
5.40					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.83E+02	1.91E+02	-4.614	
2	1.10E-04	1.37E+02	1.41E+02	-2.845	
3	1.40E-04	1.01E+02	1.01E+02	-0.563	
4	1.77E-04	7.58E+01	7.61E+01	-0.352	
5	2.20E-04	6.12E+01	6.05E+01	1.131	
6	2.80E-04	4.98E+01	4.89E+01	1.785	
7	3.55E-04	4.26E+01	4.15E+01	2.744	
8	4.43E-04	3.84E+01	3.75E+01	2.335	
9	5.64E-04	3.54E+01	3.55E+01	-0.322	
10	7.13E-04	3.44E+01	3.44E+01	0.214	
11	8.81E-04	3.37E+01	3.47E+01	-2.761	
12	1.10E-03	3.50E+01	3.73E+01	-6.217	
13	1.41E-03	3.82E+01	3.96E+01	-3.450	
14	1.80E-03	4.28E+01	4.20E+01	1.915	
15	2.22E-03	4.73E+01	4.46E+01	6.063	
16	2.80E-03	4.43E+01	4.55E+01	-2.617	
17	2.85E-03	4.79E+01	4.53E+01	5.809	
18	3.55E-03	4.16E+01	4.13E+01	0.589	
19	4.43E-03	3.78E+01	3.88E+01	-2.695	
20	5.64E-03	3.34E+01	3.41E+01	-2.143	
21	7.13E-03	2.92E+01	2.93E+01	-0.450	
22	8.81E-03	2.58E+01	2.63E+01	-1.628	
23	1.10E-02	2.38E+01	2.31E+01	2.718	

R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 23 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-24
HI FREQ

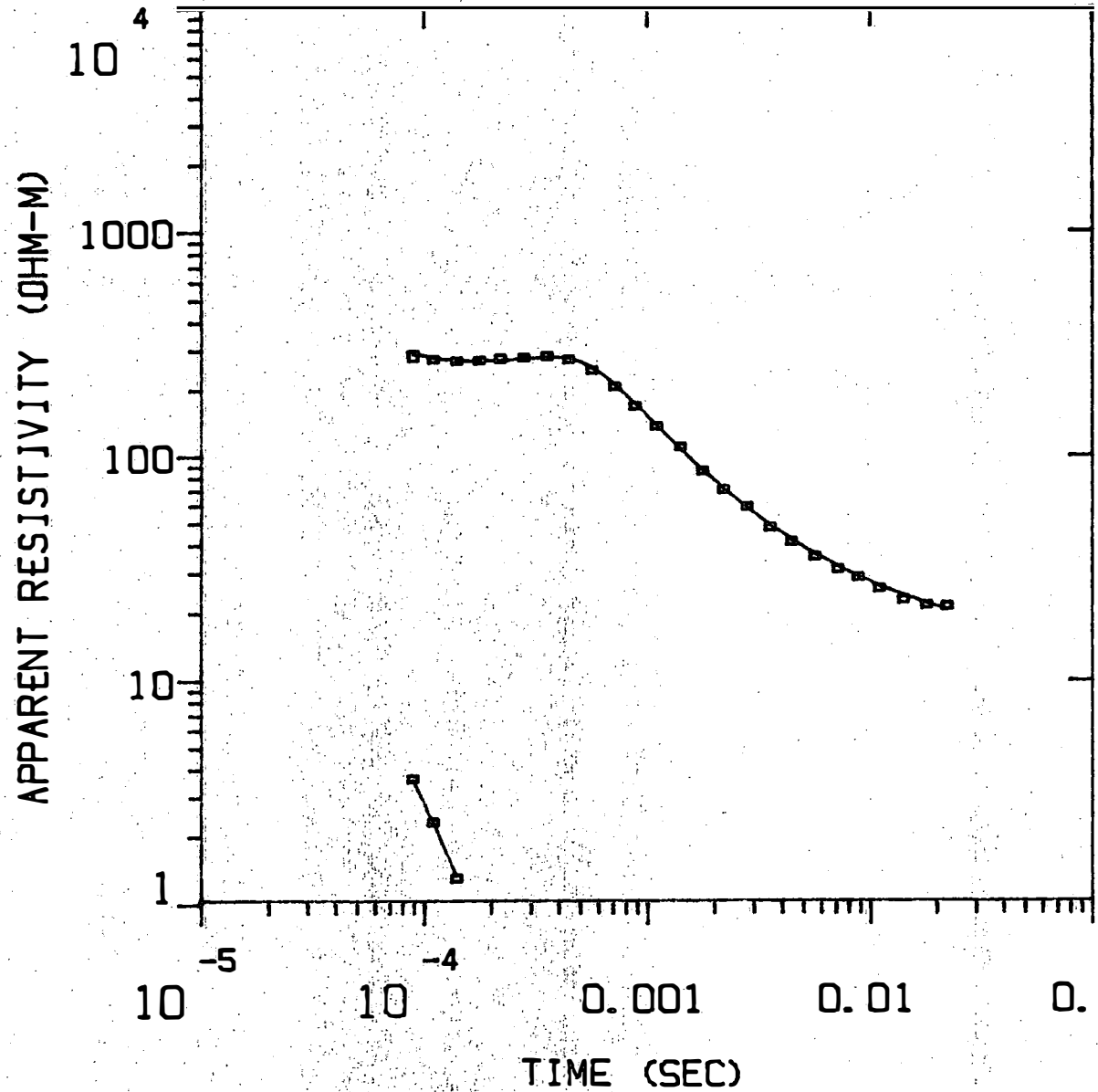
RMS LOG ERROR: 1.97E-02, ANTILOG YIELDS 4.6296 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.33						
P 2	0.09	0.56					
P 3	0.00	0.03	0.01				
P 4	0.01	0.01	-0.01	0.12			
T 1	0.09	0.09	-0.01	0.03	0.36		
T 2	-0.03	-0.44	-0.04	0.05	0.11	0.47	
T 3	-0.01	0.01	0.03	0.11	0.03	-0.02	0.90
	P 1	P 2	P 3	P 4	T 1	T 2	T 3

00-25



MODEL:

11.8
OHM-M

5.95 M

349.
OHM-M

260. M

2.86
OHM-M

25.7 M

11.1
OHM-M

χ ERROR: 2.87
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		164.9	541.0		
11.76	5.9	158.9	521.5	0.5	0.5
348.86	259.9	-100.9	-331.1	0.7	1.3
2.86	25.7	-126.6	-415.4	9.0	10.2
11.14					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.83E+02	2.88E+02	-1.862	
2	1.10E-04	2.68E+02	2.70E+02	-1.061	
3	1.40E-04	2.63E+02	2.61E+02	0.801	
4	1.77E-04	2.64E+02	2.60E+02	1.436	
5	2.20E-04	2.71E+02	2.66E+02	2.140	
6	2.80E-04	2.73E+02	2.75E+02	-0.459	
7	3.55E-04	2.79E+02	2.80E+02	-0.313	
8	4.43E-04	2.67E+02	2.72E+02	-1.684	
9	5.64E-04	2.37E+02	2.43E+02	-2.440	
10	7.13E-04	2.01E+02	2.03E+02	-1.083	
11	8.81E-04	1.64E+02	1.66E+02	-0.882	
12	1.10E-03	1.33E+02	1.32E+02	0.518	
13	1.41E-03	1.07E+02	1.03E+02	3.943	
14	1.77E-03	8.33E+01	8.29E+01	0.426	
15	2.20E-03	6.87E+01	6.83E+01	0.593	
16	2.80E-03	5.75E+01	5.61E+01	2.576	
17	3.55E-03	4.65E+01	4.70E+01	-1.059	
18	4.43E-03	4.01E+01	4.05E+01	-0.942	
19	5.64E-03	3.44E+01	3.50E+01	-1.461	
20	7.13E-03	3.03E+01	3.08E+01	-1.475	
21	8.81E-03	2.79E+01	2.78E+01	0.282	
22	1.10E-02	2.49E+01	2.53E+01	-1.432	
23	1.41E-02	2.22E+01	2.29E+01	-3.280	
24	1.80E-02	2.11E+01	2.11E+01	-0.393	
25	2.22E-02	2.08E+01	1.98E+01	4.977	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 25 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-25

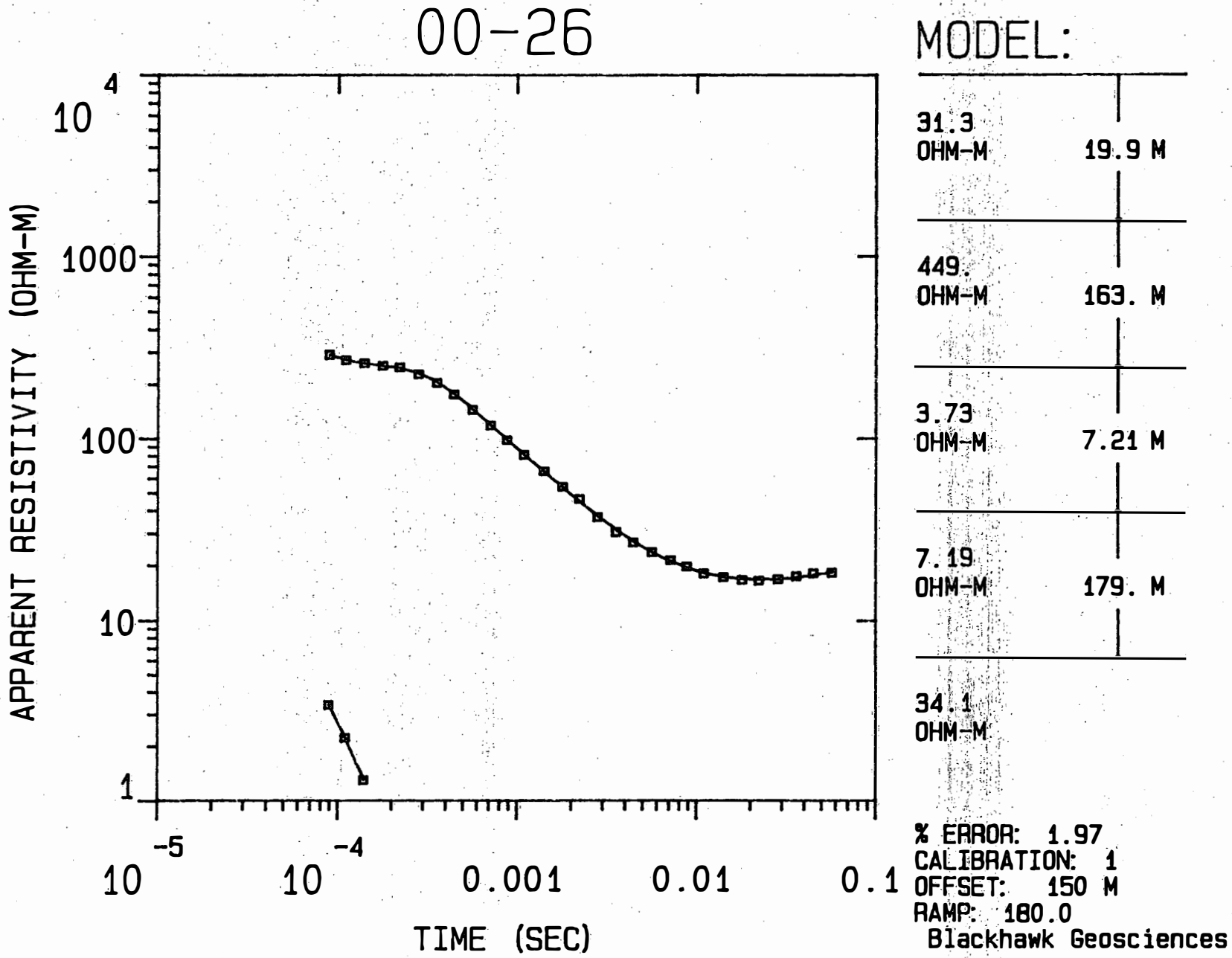
RMS LOG ERROR: 1.23E-02, ANTILOG YIELDS 2.8664 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.60					
P 2	-0.07	0.60				
P 3	0.05	-0.06	0.55			
P 4	-0.03	0.03	0.02	0.90		
T 1	-0.43	-0.23	0.03	-0.02	0.47	
T 2	0.00	0.02	0.03	0.00	0.01	1.00
T 3	-0.01	-0.01	-0.45	-0.08	-0.01	0.02	0.39

P 1 P 2 P 3 P 4 T 1 T 2 T 3


00-26
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
MODEL:
31.3
OHM-M
19.9 M
449.
OHM-M
163. M
3.73
OHM-M
7.21 M
7.19
OHM-M
179. M
34.1
OHM-M
% ERROR: 1.97
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		118.0	387.0		
31.27	19.9	98.1	321.8	0.6	0.6
449.06	163.3	-65.2	-214.0	0.4	1.0
3.73	7.2	-72.4	-237.7	1.9	2.9
7.19	178.7	-251.2	-824.0	24.9	27.8
34.07					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.91E+02	2.91E+02	-0.003	
2	1.10E-04	2.71E+02	2.72E+02	-0.207	
3	1.40E-04	2.60E+02	2.59E+02	0.399	
4	1.77E-04	2.52E+02	2.52E+02	0.023	
5	2.20E-04	2.47E+02	2.45E+02	1.156	
6	2.80E-04	2.27E+02	2.30E+02	-1.265	
7	3.55E-04	2.03E+02	2.05E+02	-1.222	
8	4.43E-04	1.76E+02	1.77E+02	-0.827	
9	5.64E-04	1.44E+02	1.45E+02	-0.876	
10	7.13E-04	1.18E+02	1.18E+02	-0.169	
11	8.81E-04	9.74E+01	9.78E+01	-0.369	
12	1.10E-03	8.07E+01	8.07E+01	0.003	
13	1.41E-03	6.55E+01	6.49E+01	0.944	
14	1.80E-03	5.38E+01	5.31E+01	1.301	
15	2.22E-03	4.62E+01	4.46E+01	3.479	
16	2.80E-03	3.66E+01	3.73E+01	-1.633	
17	3.55E-03	3.05E+01	3.13E+01	-2.732	
18	4.43E-03	2.67E+01	2.70E+01	-1.049	
19	5.64E-03	2.36E+01	2.35E+01	0.344	
20	7.13E-03	2.13E+01	2.10E+01	1.523	
21	8.81E-03	1.97E+01	1.94E+01	1.793	
22	1.10E-02	1.81E+01	1.82E+01	-0.610	
23	1.41E-02	1.73E+01	1.73E+01	-0.183	
24	1.80E-02	1.67E+01	1.69E+01	-1.147	
25	2.22E-02	1.65E+01	1.68E+01	-1.530	
26	2.85E-02	1.68E+01	1.69E+01	-0.371	
27	3.60E-02	1.75E+01	1.73E+01	1.183	
28	4.49E-02	1.81E+01	1.78E+01	1.996	
29	5.70E-02	1.82E+01	1.85E+01	-1.313	

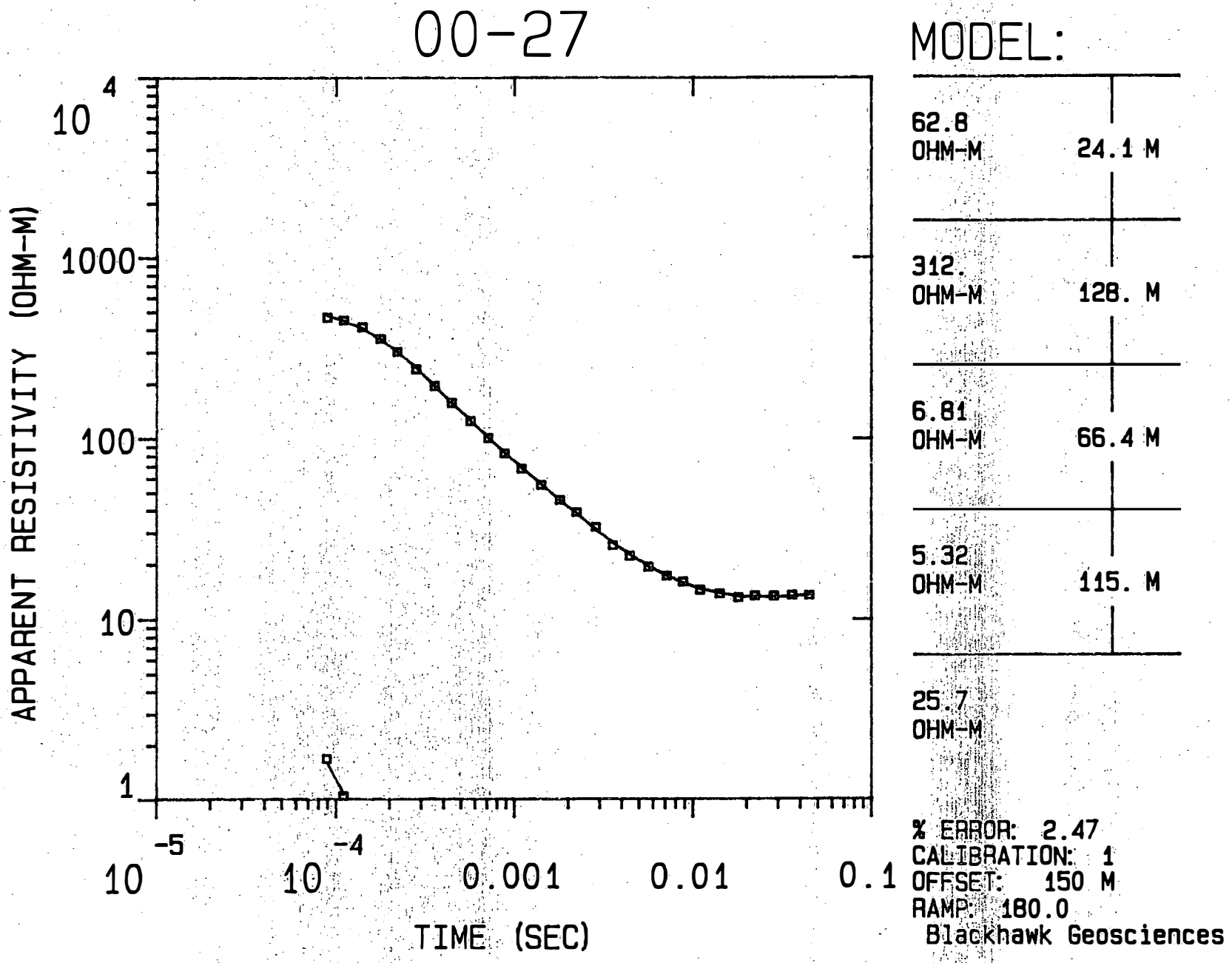
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-26

RMS LOG ERROR: 8.46E-03, ANTILOG YIELDS 1.9664 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.77
P 2 -0.02 0.07

P 3	0.06	-0.03	0.04						
P 4	0.02	-0.01	0.04	0.98					
P 5	0.01	0.00	0.03	-0.02	0.57				
T 1	-0.27	-0.19	0.08	0.02	0.02	0.65			
T 2	0.02	0.04	0.05	0.00	0.00	0.03	0.99		
T 3	-0.05	0.03	-0.03	-0.04	-0.02	-0.06	-0.02	0.02	
T 4	0.04	-0.03	-0.01	-0.04	-0.16	0.04	0.00	0.03	0.88
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4


00-27
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
MODEL:
62.8
OHM-M
24.1 M
312.
OHM-M
128. M
6.81
OHM-M
66.4 M
5.32
OHM-M
115. M
25.7
OHM-M
% ERROR: 2.47
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		105.2	345.0		
62.77	24.1	81.0	265.9	0.4	0.4
311.88	127.9	-46.9	-153.8	0.4	0.8
6.81	66.4	-113.3	-371.7	9.8	10.5
5.32	115.0	-228.3	-748.9	21.6	32.2
25.69					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	4.66E+02	4.80E+02	-3.023	
2	1.10E-04	4.49E+02	4.44E+02	1.282	
3	1.40E-04	4.11E+02	4.02E+02	2.258	
4	1.77E-04	3.54E+02	3.50E+02	1.044	
5	2.20E-04	3.00E+02	2.98E+02	0.627	
6	2.80E-04	2.41E+02	2.45E+02	-1.847	
7	3.55E-04	1.94E+02	1.93E+02	0.550	
8	4.43E-04	1.57E+02	1.56E+02	0.368	
9	5.64E-04	1.24E+02	1.26E+02	-0.915	
10	7.13E-04	1.00E+02	1.00E+02	0.175	
11	8.81E-04	8.24E+01	8.27E+01	-0.329	
12	1.10E-03	6.77E+01	6.86E+01	-1.349	
13	1.41E-03	5.51E+01	5.53E+01	-0.395	
14	1.80E-03	4.53E+01	4.50E+01	0.707	
15	2.22E-03	3.89E+01	3.80E+01	2.289	
16	2.85E-03	3.22E+01	3.10E+01	3.727	
17	3.55E-03	2.54E+01	2.63E+01	-3.325	
18	4.43E-03	2.22E+01	2.26E+01	-1.647	
19	5.64E-03	1.93E+01	1.94E+01	-0.313	
20	7.13E-03	1.72E+01	1.73E+01	-0.121	
21	8.81E-03	1.60E+01	1.57E+01	1.829	
22	1.10E-02	1.44E+01	1.46E+01	-1.248	
23	1.41E-02	1.38E+01	1.39E+01	-0.785	
24	1.80E-02	1.31E+01	1.33E+01	-1.265	
25	2.22E-02	1.34E+01	1.32E+01	1.831	
26	2.85E-02	1.34E+01	1.32E+01	1.132	
27	3.60E-02	1.35E+01	1.33E+01	1.219	
28	4.49E-02	1.35E+01	1.38E+01	-1.848	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 28 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-27

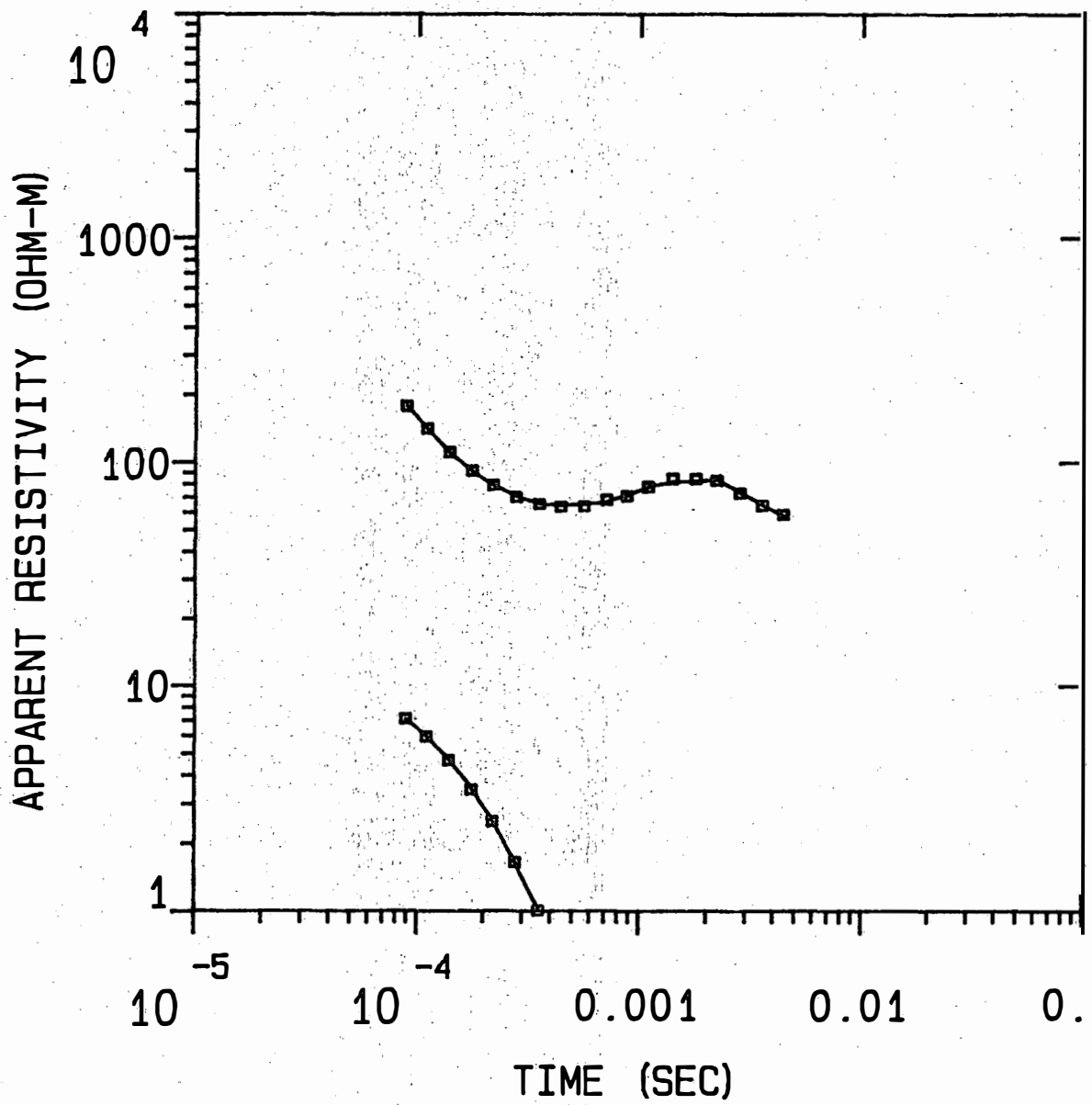
RMS LOG ERROR: 1.06E-02, ANTILOG YIELDS 2.4740 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.83
P 2 0.08 0.19
P 3 0.03 -0.08 0.92

P 4	-0.01	0.01	0.02	0.94					
P 5	0.00	0.01	0.02	-0.04	0.51				
T 1	-0.19	-0.29	0.02	-0.01	0.00	0.59			
T 2	0.03	0.09	0.01	0.00	0.00	0.08	0.98		
T 3	-0.02	0.02	0.09	0.08	-0.03	-0.03	-0.01	0.39	
T 4	0.01	-0.02	-0.03	-0.12	-0.19	0.00	0.01	0.36	0.60
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4

00-28



MODEL:

49.0 OHM-M — 33.0 M

9.66 OHM-M — 15.0 M

398. OHM-M — 283. M

6.85 OHM-M

% ERROR: 2.09
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		390.1	1280.0		
49.02	33.0	357.1	1171.7	0.7	0.7
9.66	15.0	342.2	1122.6	1.5	2.2
397.68	282.6	59.6	195.5	0.7	2.9
6.85					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.78E+02	1.79E+02	-0.763	
2	1.10E-04	1.41E+02	1.40E+02	0.363	
3	1.40E-04	1.11E+02	1.10E+02	0.730	
4	1.77E-04	9.16E+01	9.07E+01	0.957	
5	2.20E-04	7.91E+01	7.89E+01	0.338	
6	2.80E-04	6.98E+01	7.02E+01	-0.576	
7	3.55E-04	6.53E+01	6.54E+01	-0.109	
8	4.43E-04	6.34E+01	6.43E+01	-1.352	
9	5.64E-04	6.38E+01	6.53E+01	-2.211	
10	7.13E-04	6.82E+01	6.70E+01	1.830	
11	8.81E-04	7.09E+01	7.16E+01	-0.946	
12	1.10E-03	7.79E+01	7.82E+01	-0.357	
13	1.41E-03	8.45E+01	8.23E+01	2.732	
14	1.80E-03	8.44E+01	8.27E+01	2.117	
15	2.22E-03	8.28E+01	8.43E+01	-1.725	
16	2.83E-03	7.29E+01	7.35E+01	-0.866	
17	3.55E-03	6.41E+01	6.49E+01	-1.227	
18	4.43E-03	5.86E+01	5.75E+01	1.861	

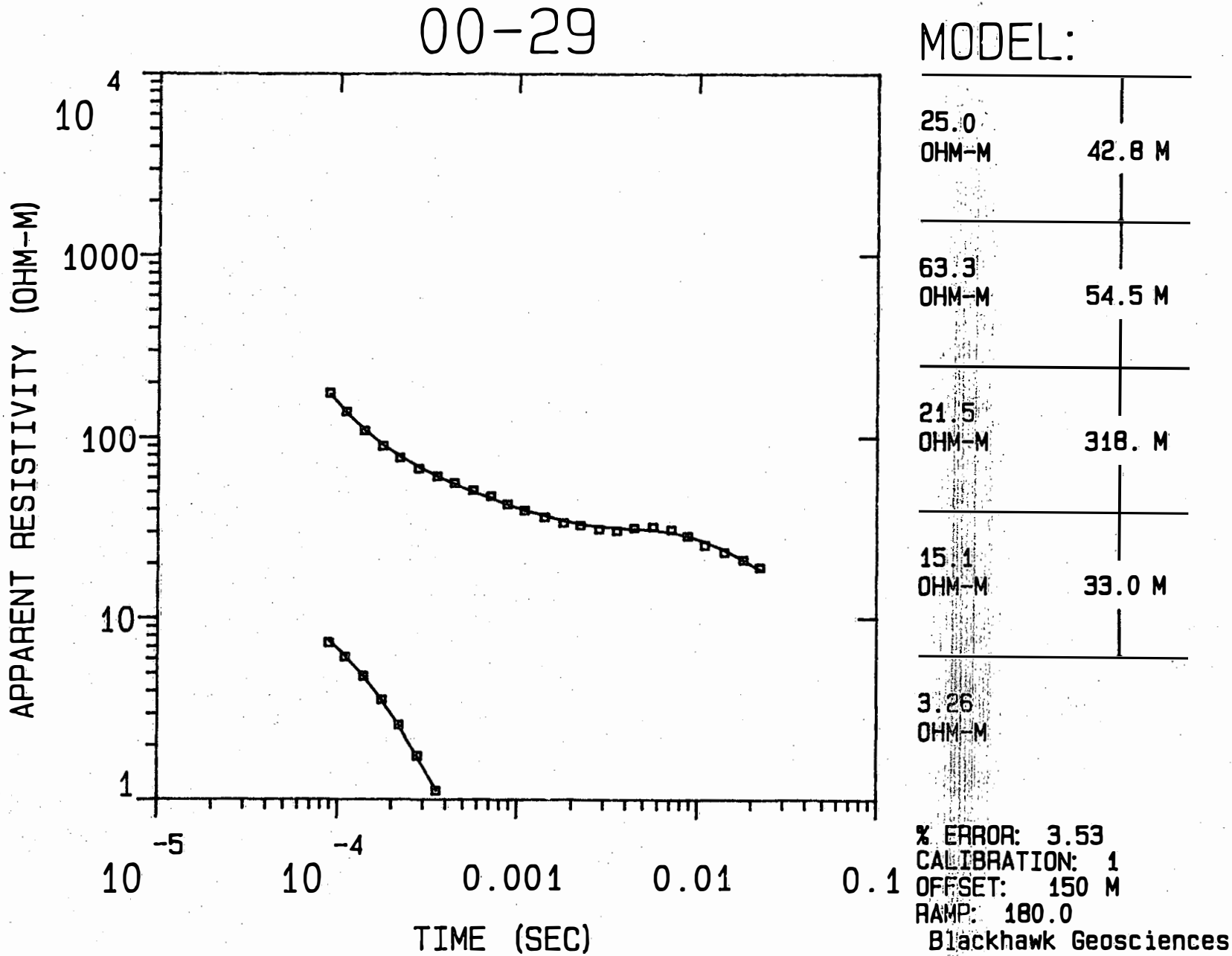
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 18 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-28

RMS LOG ERROR: 8.97E-03, ANTILOG YIELDS 2.0875 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

	P 1	P 2	P 3	P 4	T 1	T 2	T 3
P 1	0.96						
P 2	0.01	0.64					
P 3	0.00	-0.03	0.13				
P 4	-0.01	0.13	-0.15	0.49			
T 1	0.02	0.14	-0.06	-0.02	0.89		
T 2	-0.01	-0.42	-0.12	0.14	0.17	0.50	
T 3	0.00	-0.01	0.04	0.02	0.01	-0.01	1.00



MODEL:

25.0 OHM-M

42.8 M

63.3 OHM-M

54.5 M

21.5 OHM-M

318. M

15.1 OHM-M

33.0 M

3.26 OHM-M

% ERROR: 3.53
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		270.1	886.0		
25.04	42.8	227.3	745.6	1.7	1.7
63.25	54.5	172.7	566.7	0.9	2.6
21.47	317.8	-145.1	-475.9	14.8	17.4
15.09	33.0	-178.0	-584.1	2.2	19.6
3.26					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.75E+02	1.72E+02	1.582	
2	1.10E-04	1.38E+02	1.37E+02	1.032	
3	1.40E-04	1.09E+02	1.09E+02	-0.477	
4	1.77E-04	8.96E+01	9.06E+01	-1.186	
5	2.20E-04	7.72E+01	7.83E+01	-1.449	
6	2.80E-04	6.72E+01	6.85E+01	-1.826	
7	3.55E-04	6.10E+01	6.09E+01	0.111	
8	4.43E-04	5.61E+01	5.50E+01	2.054	
9	5.64E-04	5.11E+01	4.99E+01	2.323	
10	7.13E-04	4.72E+01	4.60E+01	2.464	
11	8.81E-04	4.27E+01	4.25E+01	0.370	
12	1.10E-03	3.95E+01	3.94E+01	0.236	
13	1.41E-03	3.62E+01	3.69E+01	-1.849	
14	1.80E-03	3.37E+01	3.45E+01	-2.269	
15	2.22E-03	3.27E+01	3.31E+01	-1.150	
16	2.83E-03	3.10E+01	3.21E+01	-3.269	
17	3.55E-03	3.05E+01	3.15E+01	-3.255	
18	4.43E-03	3.16E+01	3.09E+01	2.219	
19	5.64E-03	3.20E+01	3.07E+01	4.487	
20	7.13E-03	3.10E+01	2.98E+01	3.910	
21	8.81E-03	2.85E+01	2.83E+01	0.576	
22	1.10E-02	2.53E+01	2.64E+01	-4.303	
23	1.41E-02	2.31E+01	2.37E+01	-2.653	
24	1.80E-02	2.11E+01	2.09E+01	0.692	
25	2.22E-02	1.91E+01	1.85E+01	3.205	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 25 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-29

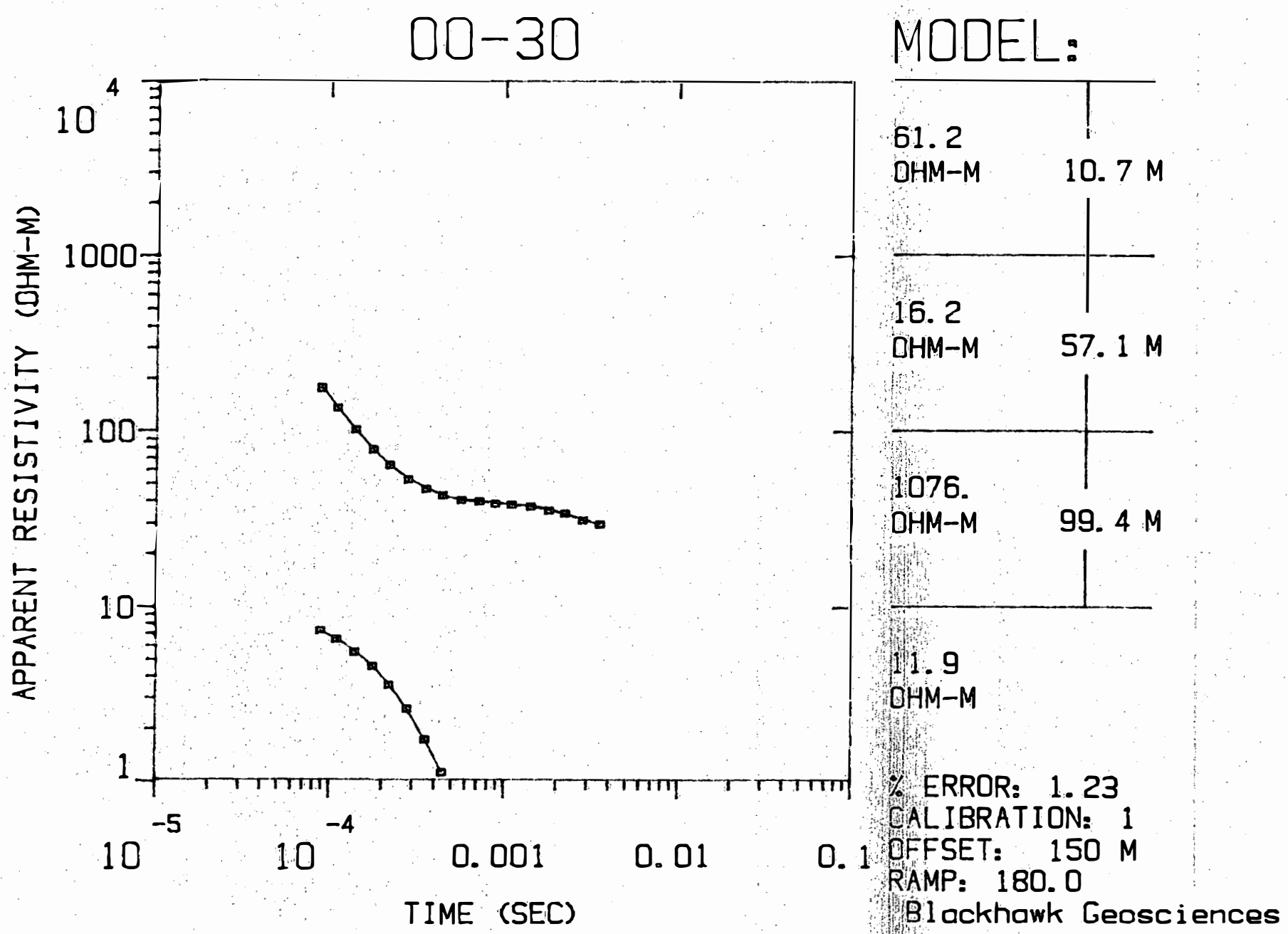
RMS LOG ERROR: 1.51E-02, ANTILOG YIELDS 3.531 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.97				
P 2	0.01	0.32			
P 3	0.01	-0.01	0.99		
P 4	0.00	0.00	0.00	0.00	
P 5	0.01	0.01	-0.04	-0.04	0.72
T 1	-0.07	-0.21	0.03	-0.01	0.05	0.70

T 2	0.01	0.38	0.02	0.00	0.03	0.13	0.74		
T 3	0.01	-0.04	0.00	0.03	0.01	0.01	0.02	0.98	
T 4	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.10	0.01
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4


00-30
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
61.2
OHM-M
10.7 M
16.2
OHM-M
57.1 M
1076.
OHM-M
99.4 M
11.9
OHM-M
% ERROR: 1.23
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		310.0	1017.0		
61.19	10.7	299.3	981.9	0.2	0.2
16.17	57.1	242.2	794.5	3.5	3.7
1076.30	99.4	142.8	468.6	0.1	3.8
11.87					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.76E+02	1.78E+02	-1.062	
2	1.10E-04	1.33E+02	1.33E+02	-0.007	
3	1.40E-04	1.00E+02	9.90E+01	1.067	
4	1.77E-04	7.68E+01	7.68E+01	0.025	
5	2.20E-04	6.31E+01	6.28E+01	0.586	
6	2.80E-04	5.21E+01	5.27E+01	-0.991	
7	3.55E-04	4.59E+01	4.63E+01	-0.847	
8	4.43E-04	4.23E+01	4.22E+01	0.177	
9	5.64E-04	3.98E+01	3.96E+01	0.413	
10	7.13E-04	3.92E+01	3.91E+01	0.399	
11	8.81E-04	3.79E+01	3.82E+01	-0.819	
12	1.10E-03	3.76E+01	3.72E+01	1.143	
13	1.41E-03	3.66E+01	3.67E+01	-0.059	
14	1.80E-03	3.48E+01	3.53E+01	-1.421	
15	2.22E-03	3.35E+01	3.30E+01	1.410	
16	2.83E-03	3.06E+01	3.08E+01	-0.815	
17	3.55E-03	2.91E+01	2.91E+01	0.164	

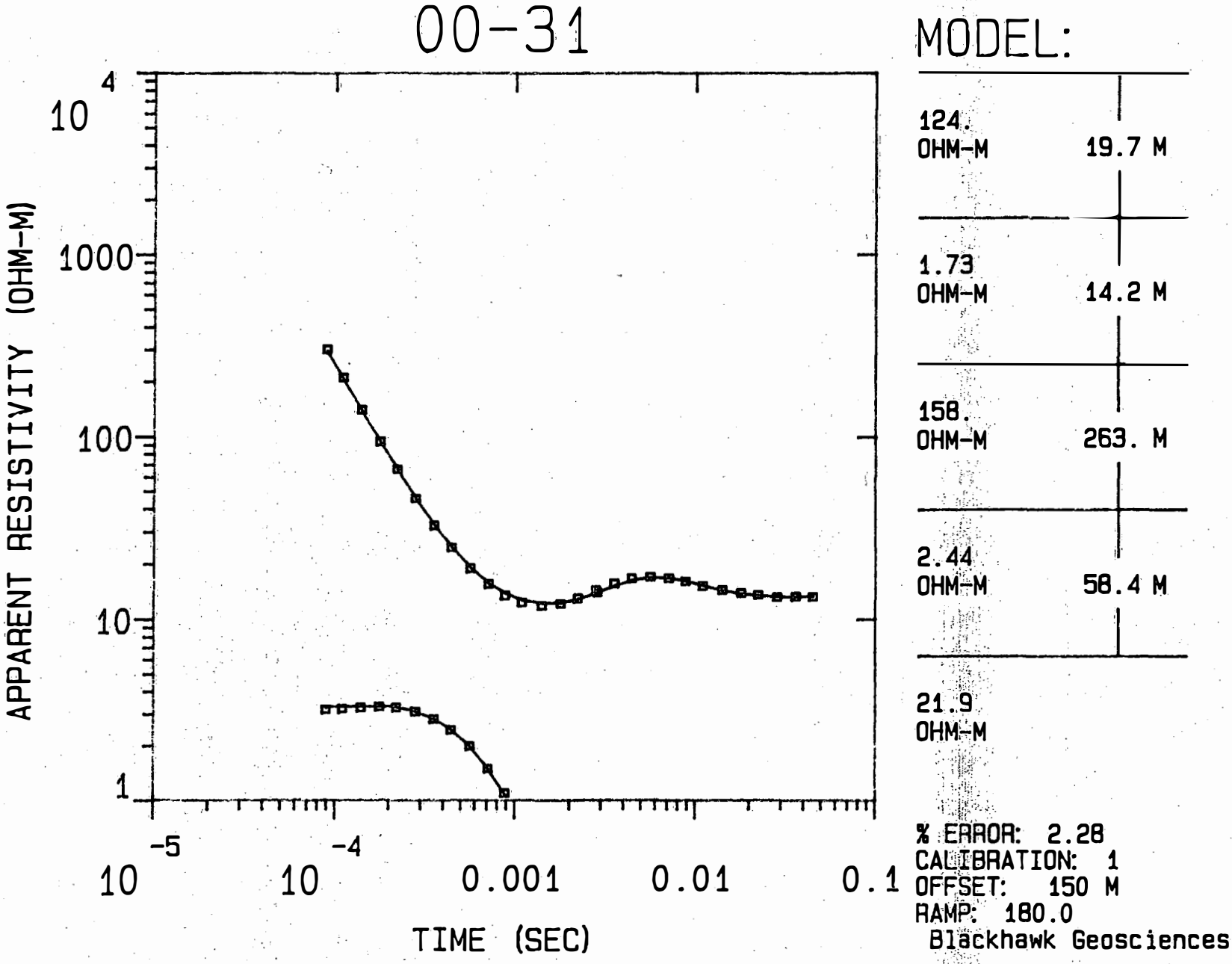
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 17 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-30

RMS LOG ERROR: 5.31E-03, ANTILOG YIELDS 1.2308 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

	P 1	P 2	P 3	P 4	T 1	T 2	T 3
P 1	0.01						
P 2	0.02	0.36					
P 3	0.00	0.00	0.00				
P 4	0.00	0.01	0.00	0.01			
T 1	0.00	0.03	0.00	0.00	0.01		
T 2	-0.01	-0.18	0.00	0.00	-0.01	0.11	
T 3	0.00	0.06	0.00	0.03	0.00	-0.03	0.08


00-31
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
MODEL:
124.
OHM-M
19.7 M
1.73
OHM-M
14.2 M
158.
OHM-M
263. M
2.44
OHM-M
58.4 M
21.9
OHM-M
% ERROR: 2.28
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		195.1	640.0		
123.62	19.7	175.4	575.3	0.2	●.2
1.73	14.2	161.2	528.8	8.2	8.4
157.64	263.0	-101.9	-334.2	1.7	1●.0
2.44	58.4	-160.2	-525.6	23.9	34.0
21.86					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	3.03E+02	2.96E+02	2.281	
2	1.10E-04	2.12E+02	2.07E+02	2.196	
3	1.40E-04	1.41E+02	1.38E+02	1.729	
4	1.77E-04	9.43E+01	9.39E+01	0.438	
5	2.20E-04	6.63E+01	6.63E+01	0.031	
6	2.80E-04	4.58E+01	4.59E+01	-0.119	
7	3.55E-04	3.28E+01	3.29E+01	-0.177	
8	4.43E-04	2.48E+01	2.49E+01	-0.123	
9	5.64E-04	1.91E+01	1.92E+01	-0.762	
10	7.13E-04	1.56E+01	1.58E+01	-0.794	
11	8.81E-04	1.36E+01	1.38E+01	-2.102	
12	1.10E-03	1.24E+01	1.27E+01	-2.509	
13	1.41E-●3	1.19E+●1	1.22E+01	-2.422	
14	1.80E-●3	1.22E+01	1.24E+01	-1.6●7	
15	2.22E-03	1.31E+01	1.30E+01	1.013	
16	2.80E-●3	1.45E+01	1.40E+●1	3.192	
17	2.85E-03	1.41E+01	1.41E+01	-0.545	
18	3.55E-●3	1.58E+●1	1.54E+01	2.801	
19	4.43E-●3	1.69E+01	1.65E+01	2.422	
20	5.64E-03	1.71E+01	1.71E+01	0.208	
21	7.13E-03	1.69E+01	1.69E+01	-0.138	
22	8.81E-03	1.62E+01	1.62E+01	0.046	
23	1.10E-02	1.52E+01	1.53E+01	-0.562	
24	1.41E-02	1.45E+01	1.44E+01	0.693	
25	1.80E-02	1.40E+01	1.38E+01	1.375	
26	2.22E-02	1.37E+01	1.34E+01	1.643	
27	2.85E-02	1.33E+01	1.33E+01	0.●09	
28	3.60E-02	1.34E+01	1.33E+01	0.543	
29	4.49E-02	1.33E+01	1.35E+01	-1.081	

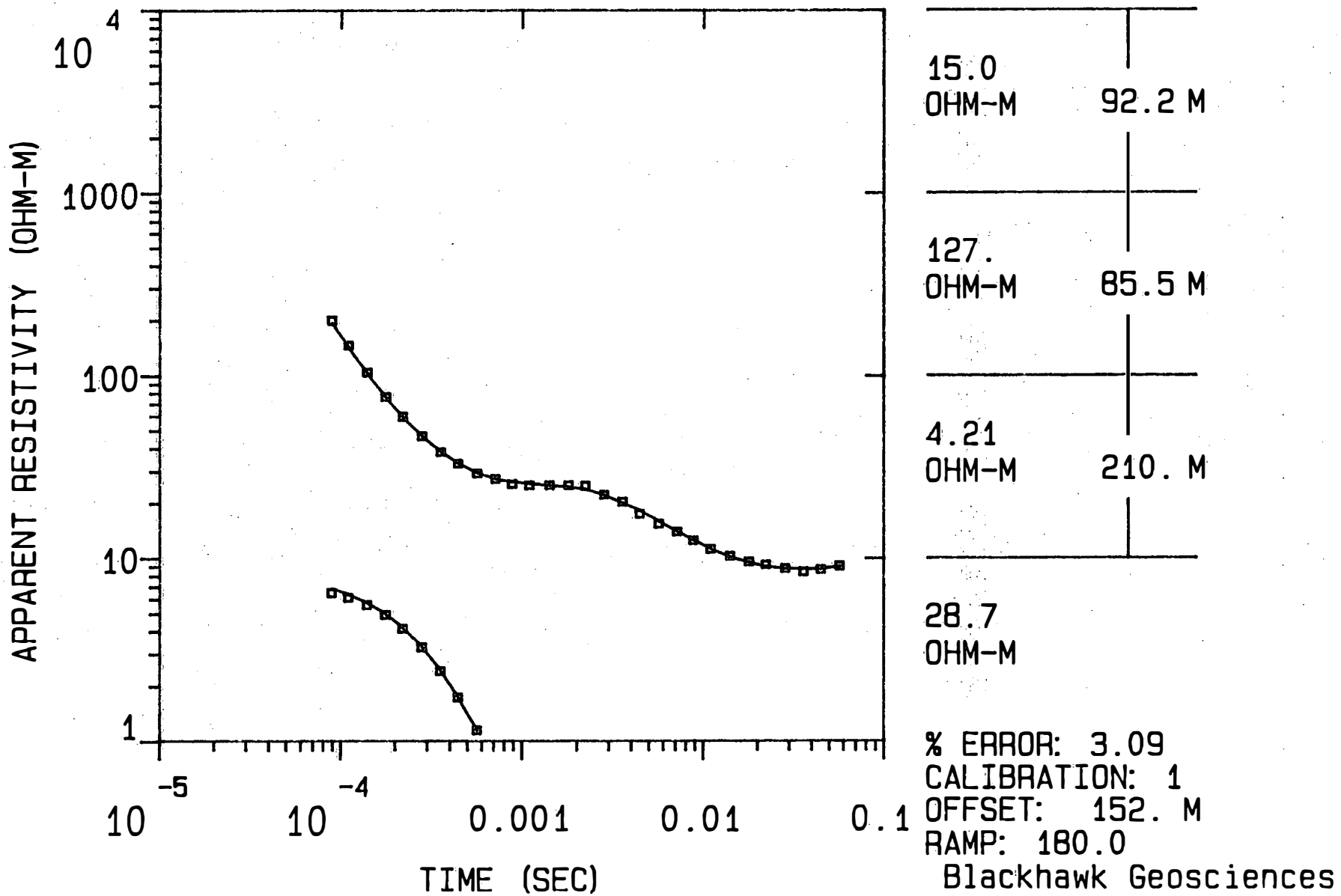
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-31

RMS LOG ERROR: 9.77E-03, ANTILOG YIELDS 2.2750 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.00
P 2 0.01 0.48

P 3	0.01	-0.07	0.04						
P 4	0.00	0.05	0.00	0.50					
P 5	0.01	-0.07	0.04	0.10	0.29				
T 1	0.03	0.18	0.02	-0.02	0.03	0.86			
T 2	-0.01	-0.33	-0.08	0.05	-0.08	0.19	0.65		
T 3	0.00	-0.05	0.04	0.08	-0.06	0.03	-0.05	0.97	
T 4	0.00	-0.02	-0.01	-0.46	-0.16	0.01	-0.02	0.04	0.45
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4



MODEL:

15.0 OHM-M — 92.2 M

127. OHM-M — 85.5 M

4.21 OHM-M — 210. M

28.7 OHM-M

% ERROR: 3.09
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		160.0	525.0		
15.00	92.2	67.8	222.5	6.1	6.1
127.40	85.5	-17.7	-57.9	0.7	6.8
4.21	210.0	-227.6	-746.8	49.9	56.7
28.74					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.00E+02	1.93E+02	3.425	
2	1.10E-04	1.46E+02	1.42E+02	2.759	
3	1.40E-04	1.04E+02	1.02E+02	1.717	
4	1.77E-04	7.65E+01	7.59E+01	0.780	
5	2.20E-04	5.96E+01	5.91E+01	0.826	
6	2.80E-04	4.67E+01	4.65E+01	0.402	
7	3.55E-04	3.83E+01	3.82E+01	0.105	
8	4.43E-04	3.31E+01	3.31E+01	0.084	
9	5.64E-04	2.92E+01	2.93E+01	-0.387	
10	7.13E-04	2.72E+01	2.71E+01	0.274	
11	8.81E-04	2.55E+01	2.62E+01	-2.379	
12	1.10E-03	2.51E+01	2.56E+01	-2.051	
13	1.41E-03	2.51E+01	2.50E+01	0.463	
14	1.80E-03	2.51E+01	2.45E+01	2.466	
15	2.22E-03	2.49E+01	2.38E+01	4.475	
16	2.83E-03	2.22E+01	2.21E+01	0.545	
17	3.57E-03	2.04E+01	2.00E+01	1.911	
18	4.43E-03	1.74E+01	1.83E+01	-4.466	
19	5.64E-03	1.54E+01	1.59E+01	-3.321	
20	7.13E-03	1.39E+01	1.39E+01	-0.132	
21	8.81E-03	1.25E+01	1.25E+01	-0.080	
22	1.10E-02	1.12E+01	1.12E+01	-0.156	
23	1.41E-02	1.03E+01	1.01E+01	1.788	
24	1.80E-02	9.56E+00	9.46E+00	1.100	
25	2.22E-02	9.21E+00	8.97E+00	2.603	
26	2.85E-02	8.80E+00	8.73E+00	0.821	
27	3.60E-02	8.43E+00	8.74E+00	-3.469	
28	4.49E-02	8.70E+00	8.72E+00	-0.224	
29	5.70E-02	9.09E+00	9.08E+00	0.139	

R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-32

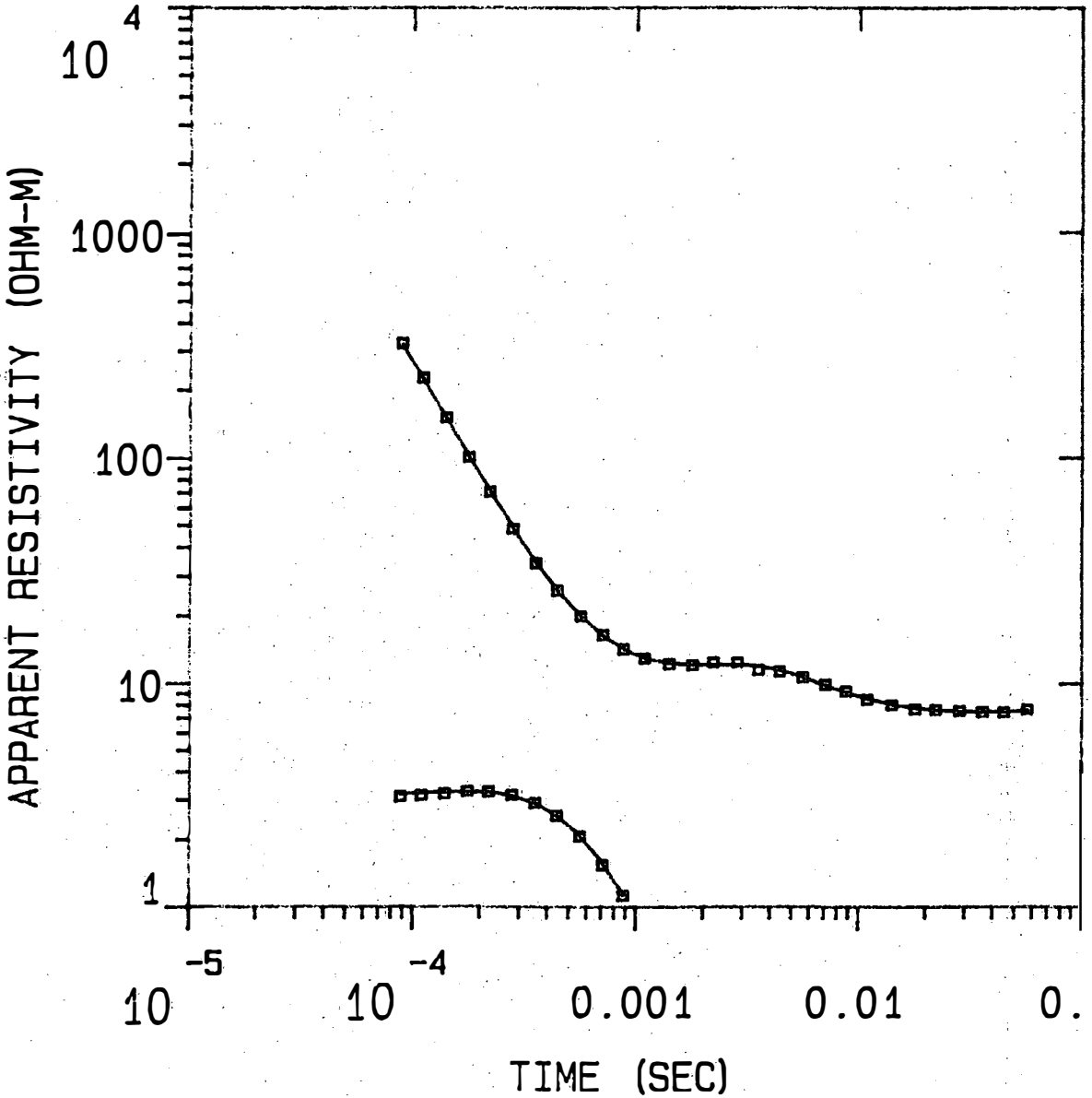
RMS LOG ERROR: 1.32E-02, ANTILOG YIELDS 3.0863 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 1.00
P 2 0.00 0.01
P 3 0.00 0.00 0.97

P 4	0.00	0.00	-0.03	0.11			
T 1	-0.01	-0.04	0.01	0.01	0.97		
T 2	0.00	0.07	0.01	0.01	0.01	0.98	
T 3	0.00	-0.01	-0.04	-0.13	0.02	0.02	0.91
	P 1	P 2	P 3	P 4	T 1	T 2	T 3

00-33



MODEL:

119. OHM-M	17.0 M
2.07 OHM-M	17.2 M
84.3 OHM-M	118. M
3.62 OHM-M	125. M
10.3 OHM-M	

% ERROR: 1.89
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		120.1	394.0		
119.43	17.0	103.1	338.2	0.1	0.1
2.07	17.2	85.8	281.7	8.3	8.5
84.28	118.1	-32.3	-105.8	1.4	9.9
3.62	125.1	-157.4	-516.4	34.6	44.4
10.35					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	3.26E+02	3.20E+02	1.719	
2	1.10E-04	2.27E+02	2.23E+02	1.709	
3	1.40E-04	1.50E+02	1.48E+02	1.319	
4	1.77E-04	1.00E+02	1.00E+02	0.022	
5	2.20E-04	7.00E+01	7.04E+01	-0.533	
6	2.80E-04	4.80E+01	4.84E+01	-0.681	
7	3.55E-04	3.42E+01	3.44E+01	-0.598	
8	4.43E-04	2.59E+01	2.59E+01	-0.040	
9	5.64E-04	1.99E+01	1.99E+01	0.169	
10	7.13E-04	1.64E+01	1.62E+01	1.048	
11	8.81E-04	1.42E+01	1.42E+01	0.106	
12	1.10E-03	1.29E+01	1.29E+01	-0.058	
13	1.41E-03	1.22E+01	1.22E+01	-0.190	
14	1.80E-03	1.21E+01	1.21E+01	0.207	
15	2.22E-03	1.24E+01	1.21E+01	2.581	
16	2.85E-03	1.24E+01	1.22E+01	2.307	
17	3.55E-03	1.15E+01	1.19E+01	-3.753	
18	4.43E-03	1.13E+01	1.14E+01	-1.139	
19	5.64E-03	1.06E+01	1.06E+01	0.037	
20	7.13E-03	9.92E+00	9.80E+00	1.180	
21	8.81E-03	9.24E+00	9.13E+00	1.173	
22	1.10E-02	8.48E+00	8.56E+00	-0.925	
23	1.41E-02	8.02E+00	8.07E+00	-0.602	
24	1.80E-02	7.69E+00	7.76E+00	-0.959	
25	2.22E-02	7.64E+00	7.59E+00	0.597	
26	2.85E-02	7.56E+00	7.49E+00	0.867	
27	3.60E-02	7.46E+00	7.48E+00	-0.284	
28	4.49E-02	7.45E+00	7.53E+00	-1.029	
29	5.70E-02	7.68E+00	7.63E+00	0.645	

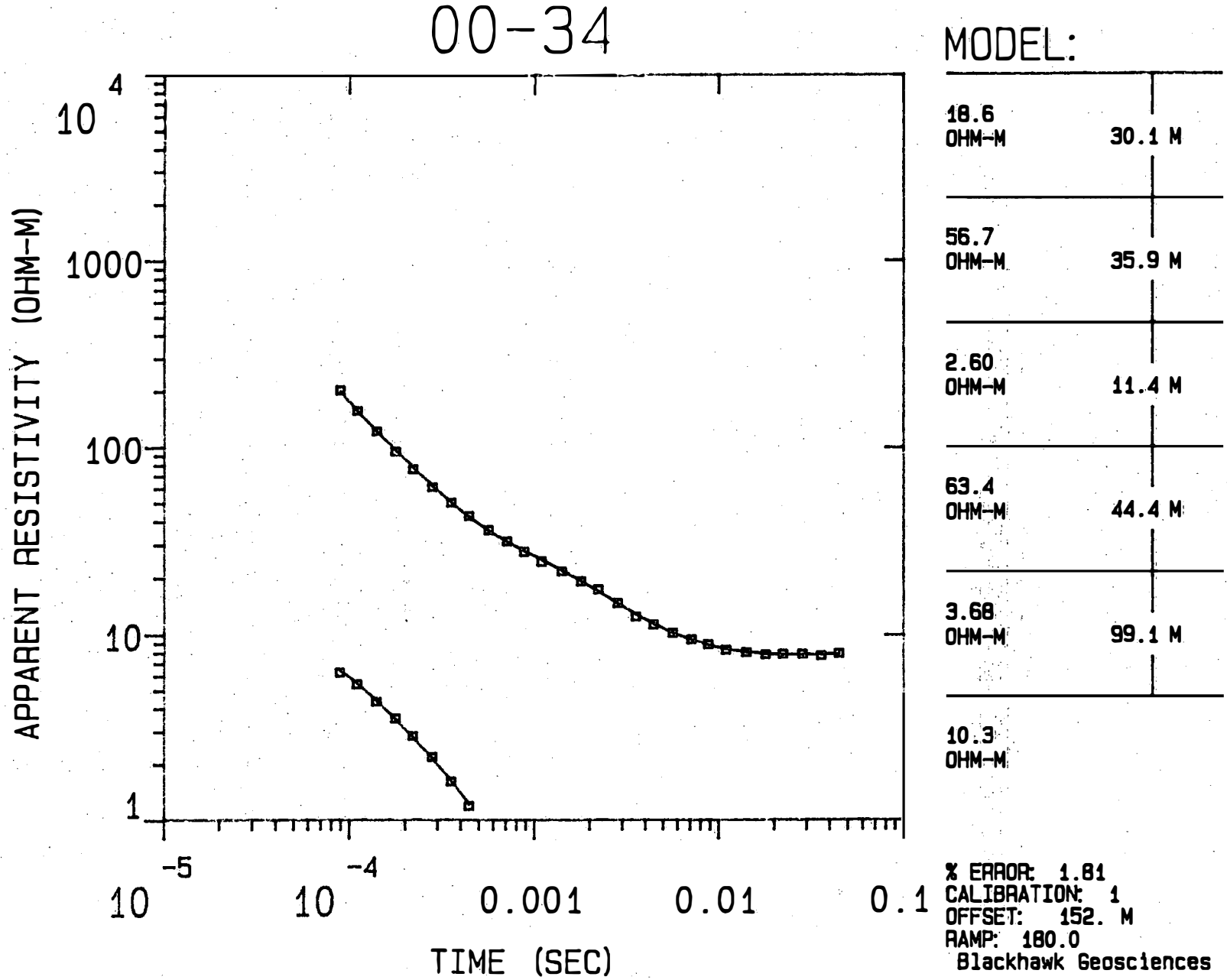
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
TDHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-33

RMS LOG ERROR: 8.12E-03, ANTILOG YIELDS 1.8864 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.00
P 2 0.01 0.67
P 3 0.00 0.00 0.01

P 4	0.00	0.08	-0.01	1.00				
P 5	0.00	-0.04	0.01	-0.04	0.46			
T 1	0.03	0.21	0.01	-0.04	0.07	0.84		
T 2	0.00	-0.35	-0.05	0.09	-0.05	0.22	0.62	
T 3	0.00	-0.06	0.04	0.09	0.00	0.04	-0.07	0.95
T 4	-0.01	0.05	-0.02	-0.27	-0.22	-0.03	0.08	0.12	0.46
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4



MODEL:

18.6 OHM-M	30.1 M
56.7 OHM-M	35.9 M
2.60 OHM-M	11.4 M
63.4 OHM-M	44.4 M
3.68 OHM-M	99.1 M
10.3 OHM-M	

% ERROR: 1.81
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 6 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		95.1	312.0		
18.60	30.1	65.0	213.4	1.6	1.6
56.66	35.9	29.2	95.7	0.6	2.2
2.60	11.4	17.8	58.5	4.4	6.6
63.41	44.4	-26.6	-87.2	0.7	7.3
3.68	99.1	-125.7	-412.3	26.9	34.2
10.34					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.04E+02	2.00E+02	1.772	
2	1.10E-04	1.58E+02	1.57E+02	0.736	
3	1.40E-04	1.22E+02	1.21E+02	0.461	
4	1.77E-04	9.49E+01	9.59E+01	-1.064	
5	2.20E-04	7.65E+01	7.77E+01	-1.485	
6	2.80E-04	6.11E+01	6.19E+01	-1.226	
7	3.55E-04	5.03E+01	5.02E+01	0.351	
8	4.43E-04	4.26E+01	4.21E+01	1.369	
9	5.64E-04	3.60E+01	3.56E+01	1.002	
10	7.13E-04	3.13E+01	3.10E+01	1.091	
11	8.81E-04	2.75E+01	2.77E+01	-1.017	
12	1.10E-03	2.45E+01	2.49E+01	-1.553	
13	1.41E-03	2.17E+01	2.19E+01	-0.870	
14	1.80E-03	1.92E+01	1.92E+01	0.178	
15	2.22E-03	1.74E+01	1.69E+01	2.821	
16	2.83E-03	1.47E+01	1.47E+01	0.509	
17	3.55E-03	1.25E+01	1.28E+01	-2.469	
18	4.43E-03	1.13E+01	1.14E+01	-0.730	
19	5.64E-03	1.02E+01	1.02E+01	0.058	
20	7.13E-03	9.43E+00	9.35E+00	0.857	
21	8.81E-03	8.89E+00	8.79E+00	1.161	
22	1.10E-02	8.31E+00	8.37E+00	-0.723	
23	1.41E-02	8.05E+00	8.06E+00	-0.069	
24	1.80E-02	7.84E+00	7.89E+00	-0.596	
25	2.22E-02	7.90E+00	7.82E+00	1.075	
26	2.85E-02	7.91E+00	7.82E+00	1.117	
27	3.60E-02	7.76E+00	7.89E+00	-1.590	
28	4.49E-02	7.97E+00	7.99E+00	-0.219	

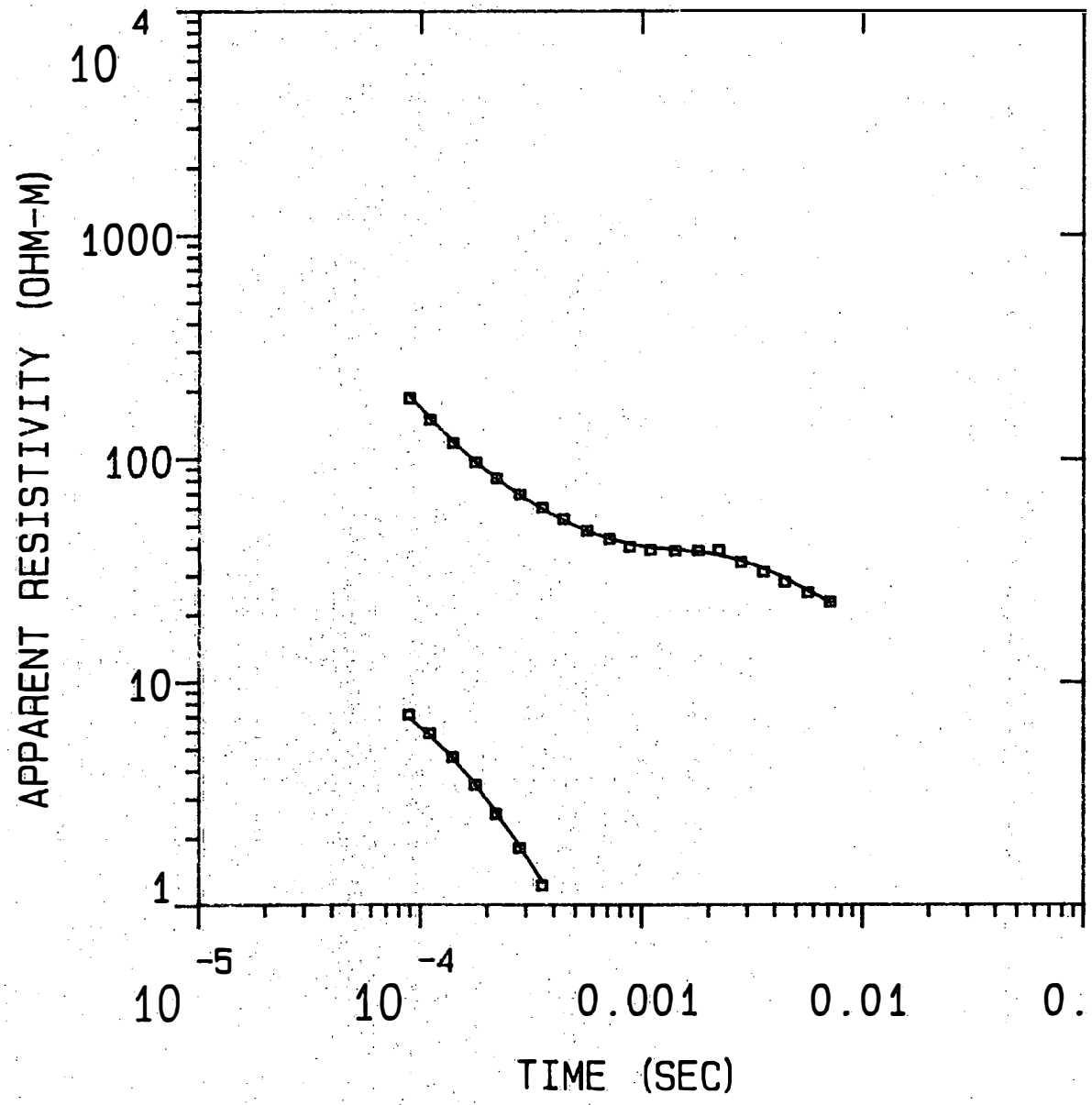
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
TDHZ ARRAY, 28 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-34

RMS LOG ERROR: 7.78E-03, ANTILOG YIELDS 1.8069 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.78
P 2 0.07 0.02

P 3	-0.01	0.04	0.37								
P 4	0.00	0.00	0.02	0.00							
P 5	0.00	-0.01	-0.03	0.01	0.73						
P 6	0.00	0.01	0.03	0.00	0.09	0.29					
T 1	-0.18	0.01	0.13	0.01	0.04	-0.03	0.21				
T 2	0.17	0.07	0.19	0.01	0.03	-0.03	0.23	0.51			
T 3	0.03	-0.02	-0.32	-0.02	0.05	-0.04	-0.08	-0.09	0.29		
T 4	-0.01	-0.02	0.05	0.03	0.19	-0.07	0.10	0.04	-0.02	0.54	
T 5	-0.01	-0.01	-0.04	0.00	-0.28	-0.20	0.05	0.03	0.05	0.13	0.30
	P 1	P 2	P 3	P 4	P 5	P 6	T 1	T 2	T 3	T 4	T 5



MODEL:

30.2 OHM-M — 145. M

6.65 OHM-M — 10.1 M

86.5 OHM-M — 101. M

4.51 OHM-M

% ERROR: 3.37
CALIBRATION: 1
OFFSET: 152. M
RAMP: 180.0

Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		160.0	525.0		
30.17	144.9	15.1	49.6	4.8	4.8
6.65	10.1	5.0	16.3	1.5	6.3
86.48	101.0	-96.0	-315.1	1.2	7.5
4.51					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.87E+02	1.92E+02	-2.759	
2	1.10E-04	1.49E+02	1.51E+02	-1.436	
3	1.40E-04	1.18E+02	1.19E+02	-0.954	
4	1.77E-04	9.63E+01	9.63E+01	0.023	
5	2.20E-04	8.18E+01	8.12E+01	0.846	
6	2.80E-04	6.93E+01	6.86E+01	1.032	
7	3.55E-04	6.05E+01	5.93E+01	2.075	
8	4.43E-04	5.37E+01	5.28E+01	1.873	
9	5.64E-04	4.76E+01	4.75E+01	0.141	
10	7.13E-04	4.37E+01	4.38E+01	-0.313	
11	8.81E-04	4.04E+01	4.15E+01	-2.592	
12	1.10E-03	3.90E+01	4.00E+01	-2.302	
13	1.41E-03	3.87E+01	3.91E+01	-0.945	
14	1.80E-03	3.88E+01	3.83E+01	1.390	
15	2.22E-03	3.90E+01	3.69E+01	5.609	
16	2.80E-03	3.45E+01	3.50E+01	-1.257	
17	3.55E-03	3.12E+01	3.24E+01	-3.671	
18	4.43E-03	2.81E+01	2.92E+01	-3.601	
19	5.64E-03	2.52E+01	2.56E+01	-1.728	
20	7.13E-03	2.28E+01	2.27E+01	0.647	

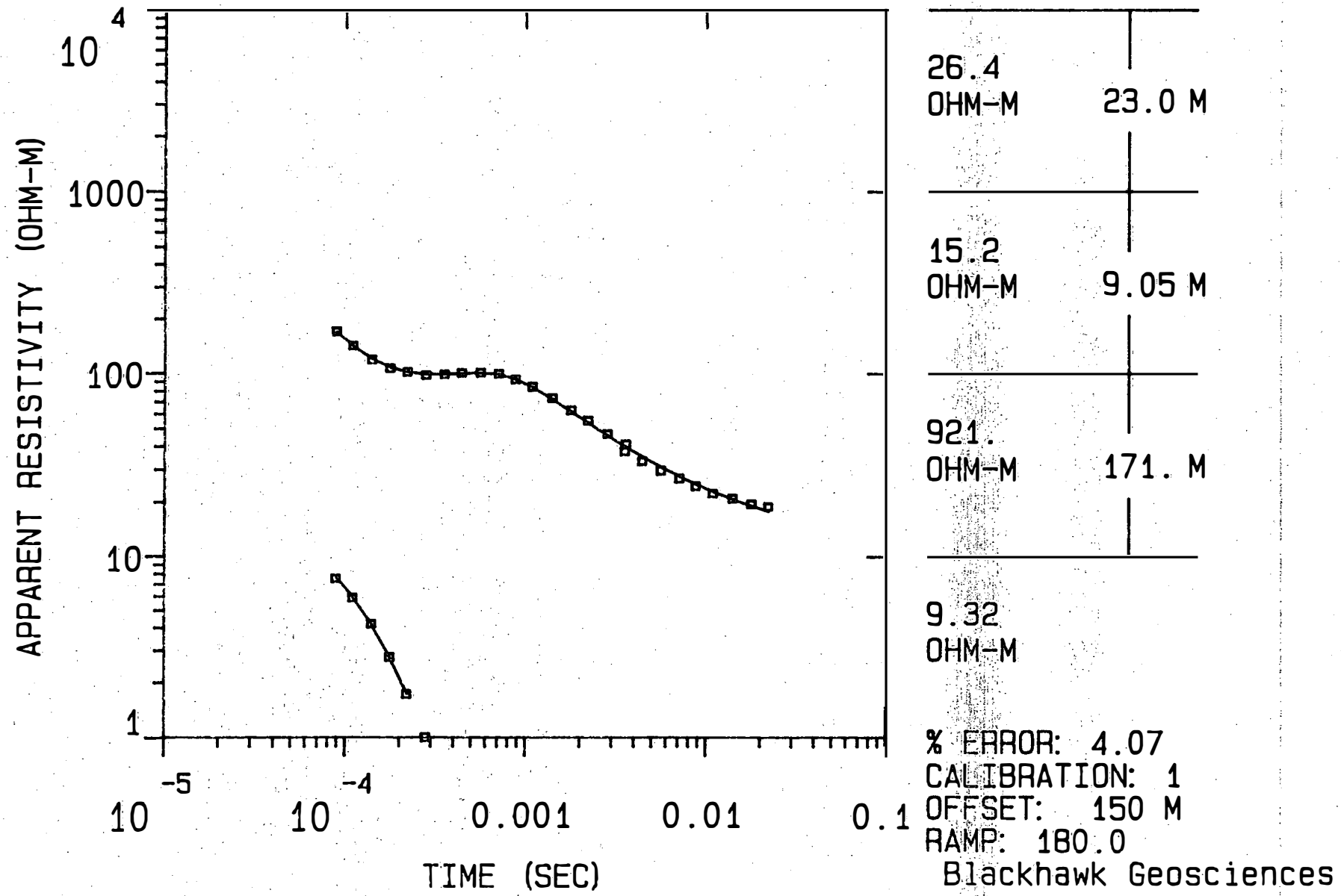
R: 152. X: 0. Y: 152. DL: 305. REQ: 169. CF: 1.0000
TDHZ ARRAY, 20 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-35

RMS LOG ERROR: 1.44E-02, ANTILOG YIELDS 3.3725 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	1.00						
P 2	0.00	0.51					
P 3	0.00	0.14	0.06				
P 4	0.00	-0.03	-0.04	0.77			
T 1	0.01	0.03	-0.04	0.07	0.90		
T 2	0.00	-0.45	-0.13	0.03	0.03	0.41	
T 3	0.00	0.01	0.11	0.00	0.07	0.02	0.93
	P 1	P 2	P 3	P 4	T 1	T 2	T 3


00-36
MODEL:
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
26.4
OHM-M
23.0 M
15.2
OHM-M
9.05 M
921.
OHM-M
171. M
9.32
OHM-M
% ERROR: 4.07
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4-LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		189.9	623.0		
26.41	23.0	166.8	547.4	0.9	0.9
15.21	9.1	157.8	517.7	0.6	1.5
921.40	170.8	-13.0	-42.7	0.2	1.7
9.32					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.71E+02	1.70E+02	0.703	
2	1.10E-04	1.42E+02	1.41E+02	0.638	
3	1.40E-04	1.19E+02	1.20E+02	-0.680	
4	1.77E-04	1.07E+02	1.07E+02	-0.697	
5	2.20E-04	1.01E+02	1.01E+02	0.220	
6	2.80E-04	9.74E+01	9.84E+01	-0.945	
7	3.55E-04	9.87E+01	9.87E+01	0.078	
8	4.43E-04	1.00E+02	1.00E+02	0.347	
9	5.64E-04	1.01E+02	1.01E+02	-0.106	
10	7.13E-04	9.94E+01	9.84E+01	1.035	
11	8.81E-04	9.23E+01	9.24E+01	-0.101	
12	1.10E-03	8.44E+01	8.35E+01	1.078	
13	1.41E-03	7.34E+01	7.20E+01	2.041	
14	1.80E-03	6.29E+01	6.16E+01	2.130	
15	2.22E-03	5.52E+01	5.35E+01	3.160	
16	2.85E-03	4.67E+01	4.57E+01	2.370	
17	3.55E-03	3.77E+01	4.00E+01	-5.758	
18	3.60E-03	4.11E+01	3.96E+01	3.739	
19	4.43E-03	3.34E+01	3.52E+01	-5.172	
20	5.64E-03	2.96E+01	3.10E+01	-4.371	
21	7.13E-03	2.69E+01	2.76E+01	-2.328	
22	8.81E-03	2.45E+01	2.50E+01	-2.269	
23	1.10E-02	2.23E+01	2.28E+01	-2.228	
24	1.41E-02	2.10E+01	2.07E+01	1.196	
25	1.80E-02	1.95E+01	1.91E+01	2.554	
26	2.22E-02	1.89E+01	1.78E+01	6.073	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 26 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-36

RMS LOG ERROR: 1.73E-02, ANTILOG YIELDS 4.0722 %
LATE TIME PARAMETERS

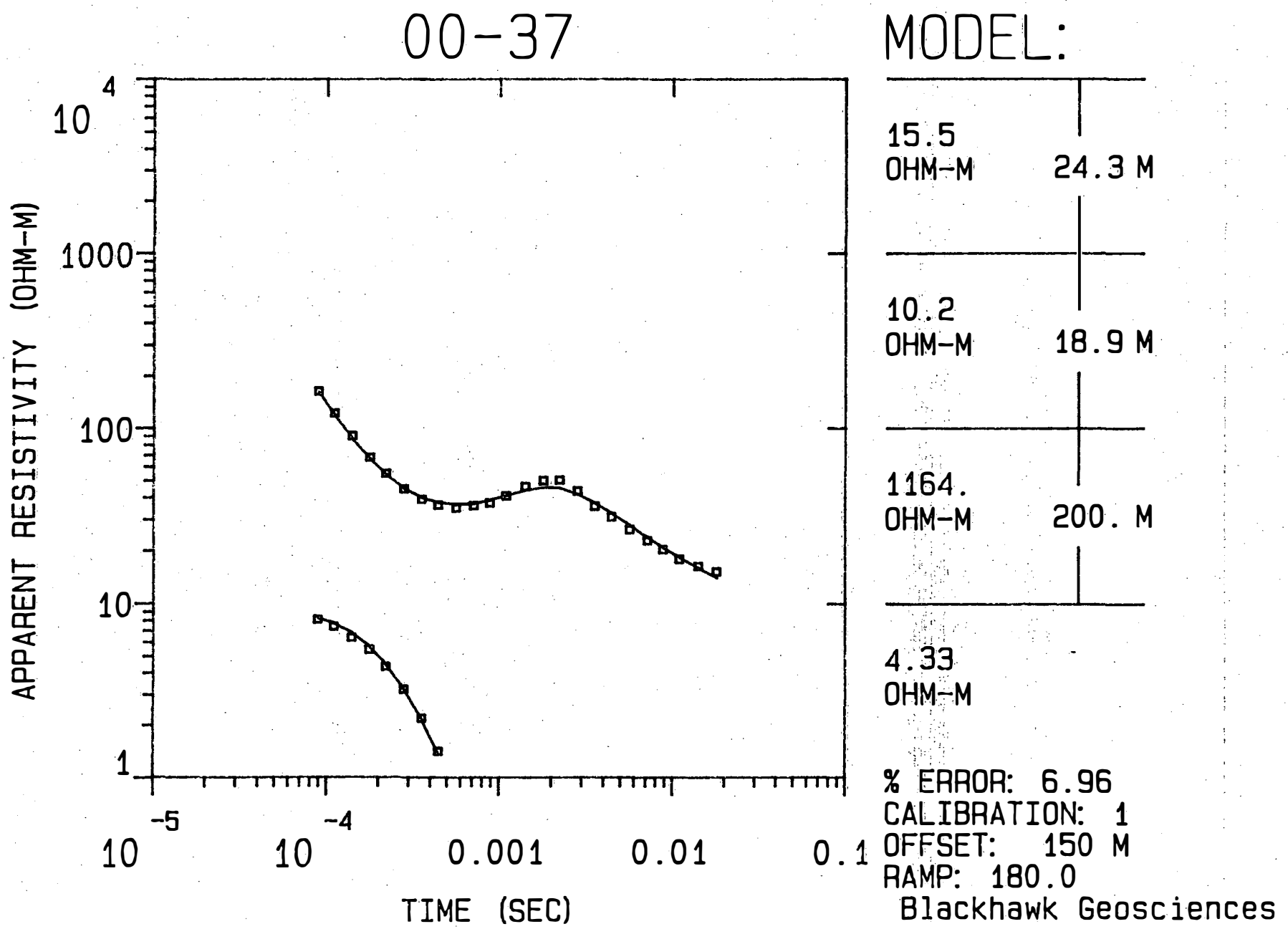
* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.86				
P 2	0.21	0.19			
P 3	-0.02	0.01	0.01		
P 4	0.01	0.01	-0.01	0.99	
T 1	0.03	-0.23	-0.06	0.02	0.60
T 2	-0.09	-0.17	-0.03	0.00	0.34	0.21

T 3 0.00 0.04 0.02 0.00 0.03 -0.01 0.99

P 1 P 2 P 3 P 4 T 1 T 2 T 3


00-37
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
MODEL:
15.5
OHM-M
24.3 M
10.2
OHM-M
18.9 M
1164.
OHM-M
200. M
4.33
OHM-M
% ERROR: 6.96
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	(FEET)	CONDUCTANCE (S) LAYER	TOTAL
		205.1	673.0		
15.51	24.3	180.8	593.1	1.6	1.6
10.15	18.9	161.9	531.2	1.9	3.4
1163.62	200.3	-38.4	-125.8	0.2	3.6
4.33					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.63E+02	1.61E+02	1.158	
2	1.10E-04	1.22E+02	1.19E+02	2.822	
3	1.40E-04	9.00E+01	8.63E+01	4.203	
4	1.77E-04	6.77E+01	6.61E+01	2.391	
5	2.20E-04	5.48E+01	5.38E+01	1.866	
6	2.80E-04	4.49E+01	4.50E+01	-0.288	
7	3.55E-04	3.91E+01	3.99E+01	-1.969	
8	4.43E-04	3.62E+01	3.73E+01	-2.979	
9	5.64E-04	3.48E+01	3.64E+01	-4.348	
10	7.13E-04	3.60E+01	3.70E+01	-2.753	
11	8.81E-04	3.73E+01	3.87E+01	-3.586	
12	1.10E-03	4.11E+01	4.12E+01	-0.324	
13	1.41E-03	4.64E+01	4.43E+01	4.724	
14	1.80E-03	5.00E+01	4.59E+01	9.097	
15	2.22E-03	5.02E+01	4.51E+01	11.322	
16	2.83E-03	4.36E+01	4.18E+01	4.424	
17	3.55E-03	3.57E+01	3.72E+01	-3.841	
18	4.43E-03	3.11E+01	3.24E+01	-4.253	
19	5.64E-03	2.63E+01	2.77E+01	-5.046	
20	7.13E-03	2.29E+01	2.38E+01	-3.961	
21	8.81E-03	2.03E+01	2.09E+01	-2.512	
22	1.10E-02	1.80E+01	1.83E+01	-2.026	
23	1.41E-02	1.64E+01	1.59E+01	2.871	
24	1.80E-02	1.53E+01	1.41E+01	8.510	

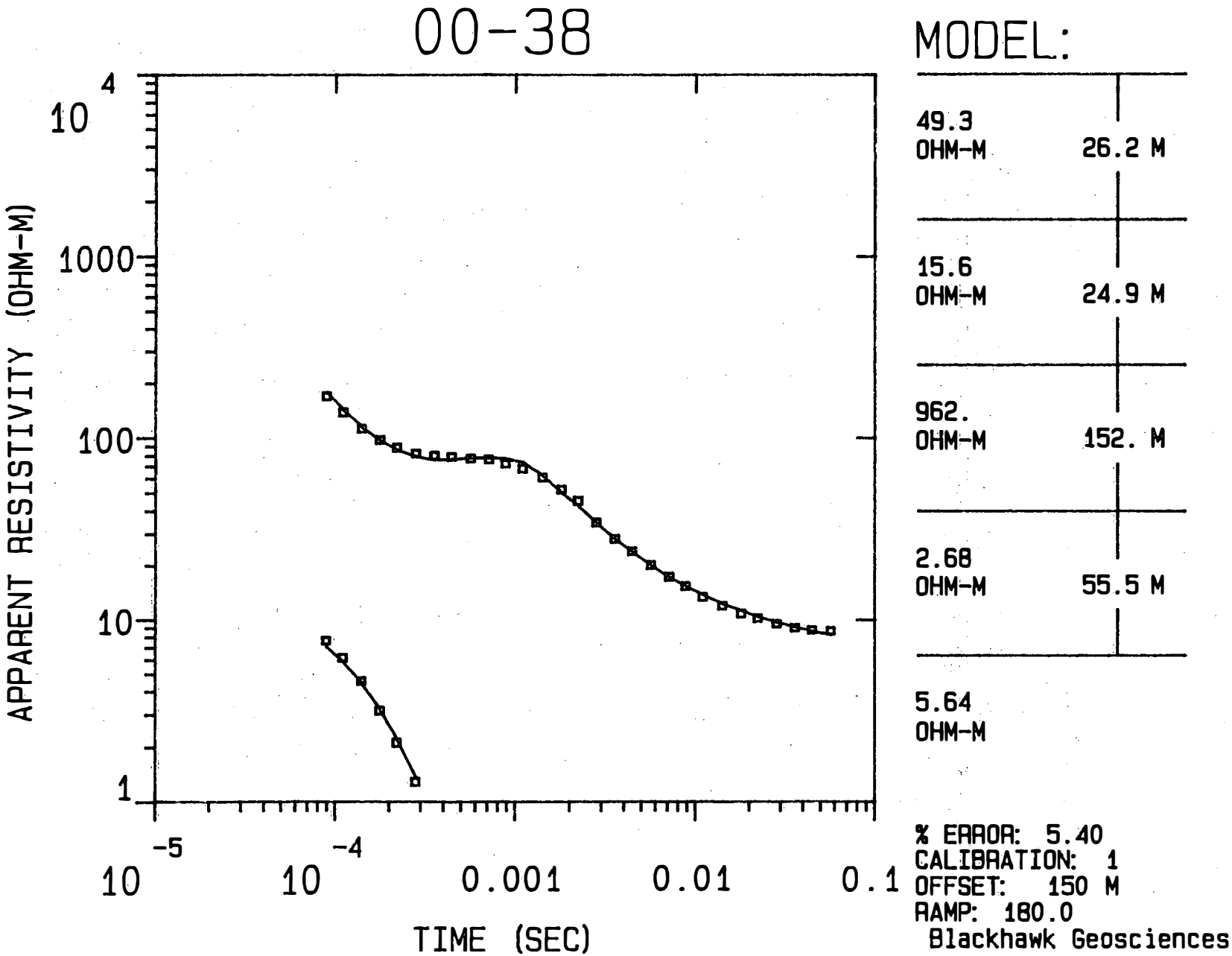
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 24 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-37

RMS LOG ERROR: 2.92E-02, ANTILOG YIELDS 6.9596 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.79						
P 2	0.22	0.32					
P 3	0.00	0.00	0.00				
P 4	0.02	0.03	-0.01	0.76			
T 1	0.04	-0.24	-0.01	0.06	0.35		
T 2	-0.06	-0.27	-0.01	0.04	0.33	0.32	
T 3	-0.01	0.04	0.01	0.04	0.03	0.01	0.98
	P 1	P 2	P 3	P 4	T 1	T 2	T 3


00-38
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
MODEL:
49.3
OHM-M
26.2 M
15.6
OHM-M
24.9 M
962.
OHM-M
152. M
2.68
OHM-M
55.5 M
5.64
OHM-M
% ERROR: 5.40
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL : 5 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		170.1	558.0		
49.29	26.2	143.9	472.0	0.5	0.5
15.64	24.9	119.0	390.4	1.6	2.1
961.84	151.9	-32.9	-107.9	0.2	2.3
2.68	55.5	-88.3	-289.8	20.7	23.0
5.64					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	1.70E+02	1.79E+02	-5.388	
2	1.10E-04	1.38E+02	1.43E+02	-3.379	
3	1.40E-04	1.12E+02	1.14E+02	-1.709	
4	1.77E-04	9.73E+01	9.64E+01	0.935	
5	2.20E-04	8.85E+01	8.60E+01	2.851	
6	2.80E-04	8.23E+01	7.90E+01	4.169	
7	3.55E-04	8.00E+01	7.56E+01	5.827	
8	4.43E-04	7.87E+01	7.62E+01	3.353	
9	5.64E-04	7.71E+01	7.84E+01	-1.664	
10	7.13E-04	7.63E+01	7.82E+01	-2.424	
11	8.81E-04	7.22E+01	7.70E+01	-6.200	
12	1.10E-03	6.79E+01	7.32E+01	-7.297	
13	1.41E-03	6.08E+01	6.23E+01	-2.414	
14	1.80E-03	5.23E+01	5.02E+01	4.240	
15	2.22E-03	4.55E+01	4.25E+01	6.849	
16	2.80E-03	3.46E+01	3.44E+01	0.555	
17	3.55E-03	2.82E+01	2.81E+01	0.417	
18	4.43E-03	2.41E+01	2.38E+01	1.001	
19	5.64E-03	2.02E+01	2.01E+01	0.409	
20	7.13E-03	1.74E+01	1.73E+01	0.790	
21	8.81E-03	1.54E+01	1.54E+01	0.005	
22	1.10E-02	1.34E+01	1.38E+01	-2.675	
23	1.41E-02	1.20E+01	1.23E+01	-2.265	
24	1.80E-02	1.08E+01	1.13E+01	-4.036	
25	2.22E-02	1.02E+01	1.04E+01	-1.898	
26	2.85E-02	9.52E+00	9.69E+00	-1.766	
27	3.60E-02	9.04E+00	9.11E+00	-0.763	
28	4.49E-02	8.78E+00	8.62E+00	1.787	
29	5.70E-02	8.68E+00	8.25E+00	5.253	

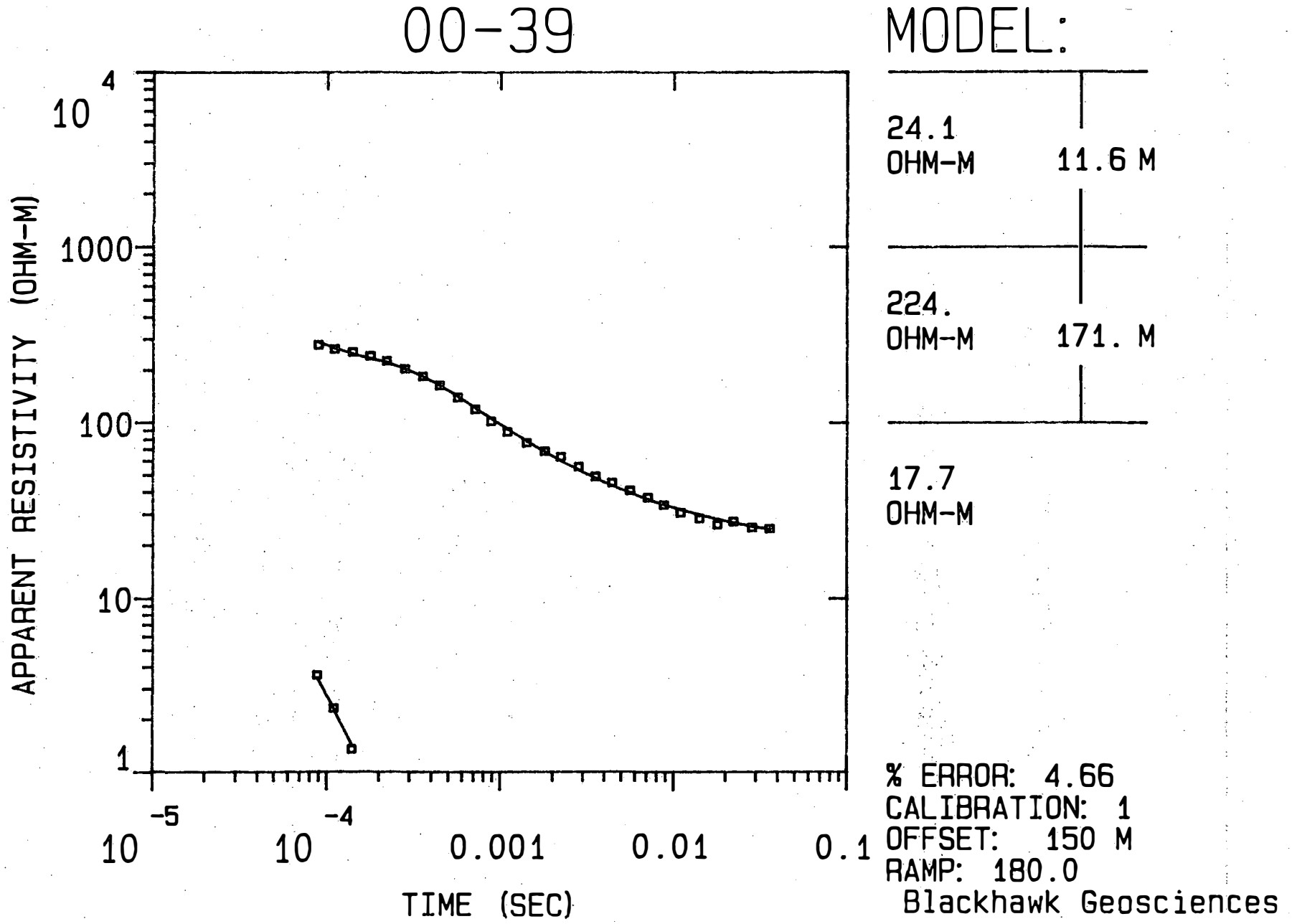
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 29 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-38

RMS LOG ERROR: 2.28E-02, ANTILOG YIELDS 5.4022 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER
P 1 0.63
P 2 0.12 0.62

P 3	0.09	0.01	0.00						
P 4	-0.01	0.05	0.00	0.62					
P 5	0.00	-0.02	0.00	0.08	0.81				
T 1	0.12	0.09	-0.01	0.05	-0.02	0.43			
T 2	-0.03	-0.40	-0.02	0.08	-0.03	0.20	0.48		
T 3	-0.01	0.03	0.01	0.05	-0.01	0.05	0.02	0.98	
T 4	0.00	0.00	0.00	-0.34	-0.12	0.02	0.01	0.04	0.23
	P 1	P 2	P 3	P 4	P 5	T 1	T 2	T 3	T 4


00-39
MODEL:
APPARENT RESISTIVITY (OHM-M)
10 4
1000
100
10
1
10 -5
10 -4
0.001
0.01
0.1
TIME (SEC)
24.1
OHM-M
11.6 M
224.
OHM-M
171. M
17.7
OHM-M
% ERROR: 4.66
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		199.9	656.0		
24.13	11.6	188.4	618.0	0.5	0.5
223.60	170.8	17.6	57.6	0.8	1.2
17.74					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	2.80E+02	2.90E+02	-3.632	
2	1.10E-04	2.64E+02	2.66E+02	-0.808	
3	1.40E-04	2.53E+02	2.47E+02	2.582	
4	1.77E-04	2.41E+02	2.33E+02	3.395	
5	2.20E-04	2.26E+02	2.20E+02	2.518	
6	2.80E-04	2.04E+02	2.04E+02	0.136	
7	3.55E-04	1.84E+02	1.84E+02	-0.005	
8	4.43E-04	1.64E+02	1.64E+02	-0.155	
9	5.64E-04	1.40E+02	1.41E+02	-1.267	
10	7.13E-04	1.19E+02	1.21E+02	-1.551	
11	8.81E-04	1.01E+02	1.05E+02	-3.687	
12	1.10E-03	8.81E+01	9.12E+01	-3.429	
13	1.41E-03	7.65E+01	7.79E+01	-1.778	
14	1.80E-03	6.83E+01	6.76E+01	0.969	
15	2.22E-03	6.34E+01	6.01E+01	5.429	
16	2.83E-03	5.57E+01	5.33E+01	4.579	
17	3.55E-03	4.91E+01	4.78E+01	2.647	
18	4.43E-03	4.54E+01	4.35E+01	4.316	
19	5.64E-03	4.08E+01	3.96E+01	3.076	
20	7.13E-03	3.73E+01	3.64E+01	2.471	
21	8.81E-03	3.39E+01	3.40E+01	-0.216	
22	1.10E-02	3.07E+01	3.19E+01	-3.808	
23	1.41E-02	2.85E+01	2.98E+01	-4.453	
24	1.80E-02	2.63E+01	2.82E+01	-6.595	
25	2.22E-02	2.74E+01	2.69E+01	1.884	
26	2.85E-02	2.53E+01	2.56E+01	-1.430	
27	3.60E-02	2.49E+01	2.47E+01	0.962	

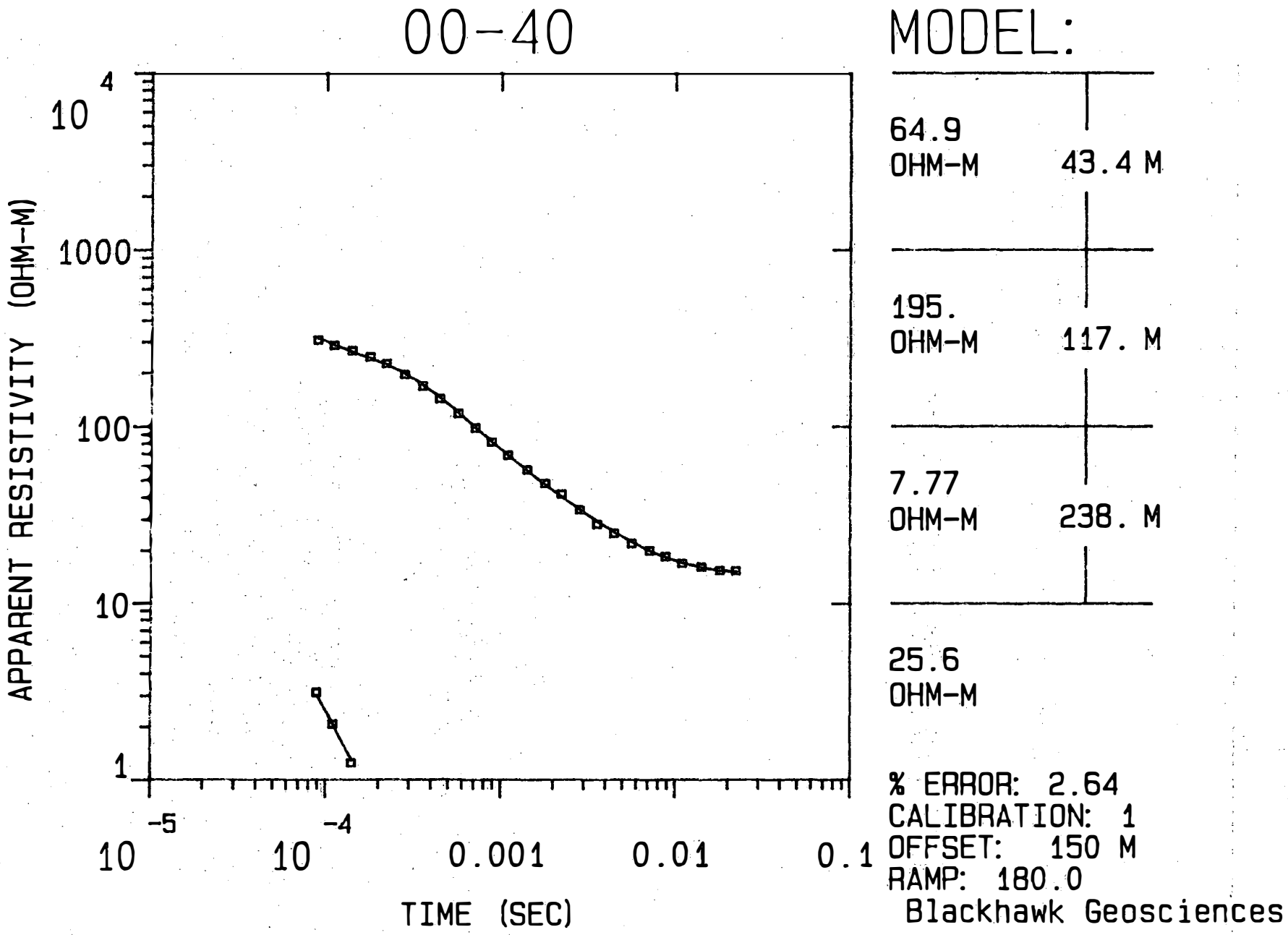
R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 27 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-39

RMS LOG ERROR: 1.98E-02, ANTILOG YIELDS 4.6646 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.76				
P 2	-0.15	0.81			
P 3	0.00	0.00	1.00		
T 1	-0.37	-0.28	0.00	0.40	
T 2	0.04	0.04	0.00	0.07	0.99
	P 1	P 2	P 3	T 1	T 2


00-40
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
64.9
OHM-M
43.4 M
195.
OHM-M
117. M
7.77
OHM-M
238. M
25.6
OHM-M
% ERROR: 2.64
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 4 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		97.8	321.0		
64.94	43.4	54.4	178.6	0.7	0.7
195.13	116.6	-62.1	-203.8	0.6	1.3
7.77	237.6	-299.7	-983.2	30.6	31.8
25.57					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	3.08E+02	3.16E+02	-2.793	
2	1.10E-04	2.85E+02	2.86E+02	-0.334	
3	1.40E-04	2.67E+02	2.61E+02	2.304	
4	1.77E-04	2.46E+02	2.41E+02	2.286	
5	2.20E-04	2.25E+02	2.22E+02	1.445	
6	2.80E-04	1.95E+02	1.98E+02	-1.202	
7	3.55E-04	1.68E+02	1.71E+02	-1.583	
8	4.43E-04	1.43E+02	1.45E+02	-1.595	
9	5.64E-04	1.18E+02	1.19E+02	-1.432	
10	7.13E-04	9.76E+01	9.78E+01	-0.219	
11	8.81E-04	8.14E+01	8.19E+01	-0.576	
12	1.10E-03	6.86E+01	6.84E+01	0.227	
13	1.41E-03	5.69E+01	5.61E+01	1.560	
14	1.80E-03	4.78E+01	4.68E+01	2.233	
15	2.22E-03	4.17E+01	4.01E+01	3.910	
16	2.83E-03	3.40E+01	3.40E+01	-0.003	
17	3.55E-03	2.82E+01	2.93E+01	-3.542	
18	4.43E-03	2.51E+01	2.55E+01	-1.708	
19	5.64E-03	2.19E+01	2.23E+01	-1.742	
20	7.13E-03	2.00E+01	1.99E+01	0.247	
21	8.81E-03	1.85E+01	1.83E+01	1.324	
22	1.10E-02	1.70E+01	1.70E+01	-0.425	
23	1.41E-02	1.62E+01	1.60E+01	0.796	
24	1.80E-02	1.55E+01	1.54E+01	0.131	
25	2.22E-02	1.54E+01	1.52E+01	1.433	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 25 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-40

RMS LOG ERROR: 1.13E-02, ANTILOG YIELDS 2.6372 %
LATE TIME PARAMETERS

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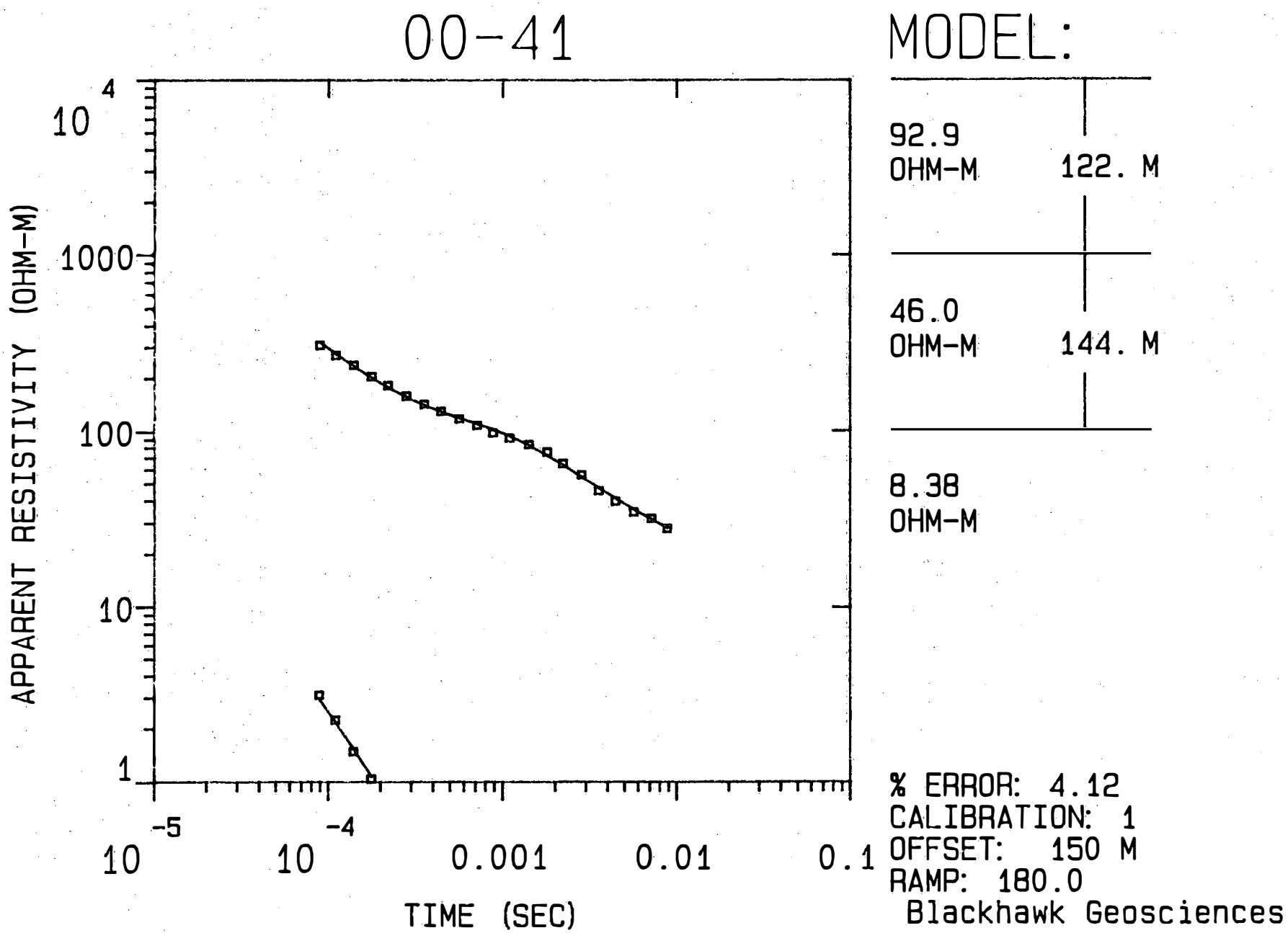
PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

P 1	0.97					
P 2	-0.06	0.33				
P 3	0.00	-0.01	1.00			
P 4	0.01	-0.03	-0.01	0.69		
T 1	-0.03	-0.39	0.00	0.01	0.68	
T 2	0.04	0.19	0.00	0.00	0.14	0.93
T 3	0.01	-0.03	-0.01	-0.12	0.00	0.00	0.94


00-41
MODEL:
APPARENT RESISTIVITY (OHM-M)
10^4
1000
100
10
1
10^-5
10^-4
0.001
0.01
0.1
TIME (SEC)
92.9
OHM-M
122. M
46.0
OHM-M
144. M
8.38
OHM-M
% ERROR: 4.12
CALIBRATION: 1
OFFSET: 150 M
RAMP: 180.0
Blackhawk Geosciences

MODEL: 3 LAYERS

RESISTIVITY (OHM-M)	THICKNESS (M)	ELEVATION (M)	ELEVATION (FEET)	CONDUCTANCE (S) LAYER	CONDUCTANCE (S) TOTAL
		188.1	617.0		
92.89	122.1	65.9	216.3	1.3	1.3
45.99	143.8	-77.8	-255.4	3.1	4.4
8.38					

	TIMES	DATA	CALC	% ERROR	STD ERR
1	8.90E-05	3.09E+02	3.23E+02	-4.405	
2	1.10E-04	2.70E+02	2.76E+02	-2.038	
3	1.40E-04	2.38E+02	2.33E+02	1.863	
4	1.77E-04	2.05E+02	2.01E+02	1.809	
5	2.20E-04	1.82E+02	1.77E+02	2.746	
6	2.80E-04	1.58E+02	1.56E+02	1.603	
7	3.55E-04	1.41E+02	1.39E+02	1.413	
8	4.43E-04	1.29E+02	1.28E+02	0.843	
9	5.64E-04	1.17E+02	1.18E+02	-0.754	
10	7.13E-04	1.07E+02	1.09E+02	-1.713	
11	8.81E-04	9.69E+01	1.01E+02	-4.251	
12	1.10E-03	9.05E+01	9.25E+01	-2.240	
13	1.41E-03	8.30E+01	8.18E+01	1.432	
14	1.80E-03	7.52E+01	7.15E+01	5.214	
15	2.21E-03	6.48E+01	6.30E+01	2.811	
16	2.83E-03	5.58E+01	5.41E+01	3.207	
17	3.55E-03	4.54E+01	4.69E+01	-3.160	
18	4.43E-03	3.96E+01	4.10E+01	-3.212	
19	5.64E-03	3.44E+01	3.56E+01	-3.286	
20	7.13E-03	3.18E+01	3.13E+01	1.590	
21	8.81E-03	2.78E+01	2.80E+01	-0.720	

R: 150. X: 0. Y: 150. DL: 300. REQ: 167. CF: 1.0000
CLHZ ARRAY, 21 DATA POINTS, RAMP: 180.0 MICROSEC, DATA: 00-41

RMS LOG ERROR: 1.75E-02, ANTILOG YIELDS 4.1167 %
LATE TIME PARAMETERS

* Blackhawk Geosciences *

PARAMETER RESOLUTION MATRIX:
"F" MEANS FIXED PARAMETER

	P 1	P 2	P 3	T 1	T 2
P 1	0.92				
P 2	0.01	0.46			
P 3	0.00	-0.12	0.39		
T 1	0.08	0.32	0.04	0.54	
T 2	-0.07	-0.10	0.15	0.30	0.63